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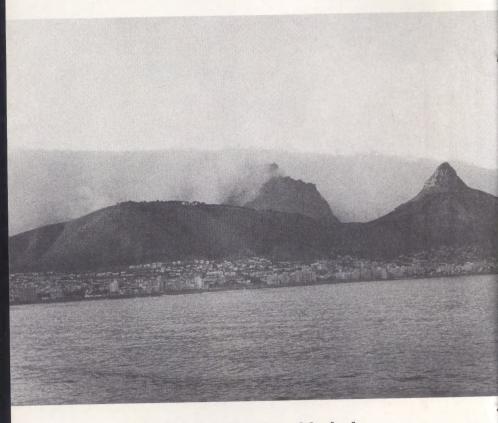


Table Mountain's tablecloth

THE SPECTACULAR scenic setting of Capetown, South Africa, is famous for its backdrop of mountains—Lion's Head, at right in the photo above, Signal Mountain to the left and dominated by the awesome flat-topped alp in the background—Table Mountain. The aptly-named mass of rock is not only a world landmark, but a popular tourist mecca, reached via aerial tramway by visitors from everywhere. Occasionally, when wind and weather are right, Table Mountain puts on

a unique show. Low-hanging clouds cling to its surface, draping over the steep sides and making the mountain look like a banquet table set for a feast. Naturally enough, the tricky phenomenon is called "Table Mountain's tablecloth," which you see here. Pictures of the event are rarely seen, because the mist usually drapes itself in early morning, and is best seen from the waters of Table Bay. This photograph was taken from the deck of an oceanographic ship en route to Cape of Good Hope.

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BACK AROUND 1950, Princeton University had a laboratory designed to disorient perfectly normal folk. It was in a darkened basement area known to students as "the dungeon." Down there, they'd built a whole world of utter confusion that literally out-horrified the Coney Island House of Horrors. I recall going there and coming out, after a day of total confoundment. Level floors slipped away under my feet like precipitous cliffs; high ceilings descended on my head; balls rolled uphill; a jumble of sticks, like jack-

THIS MONTH

straws, assembled themselves into a chair before my eyes. I watched a mouse cross a room and grow to elephant size enroute. This was Princeton's "illusion lab," established by Professor Merle Lawrence, a Princeton psychologist, to carry forward work begun by an optical physicist, Adelbert Ames, of Hanover, N. H. Object: to explore the nether regions of the mind. By observing how people interpret and act on what they see, these scientists hoped to learn new things about the brain mechanisms behind human behavior. "What you see depends not so much on what is there, as on the assumptions you make when you look," is how one of them put it.

Well, today, this same work is going on at the City College of New York Graduate School. Barbara Ford has brought it up to date, on page 45. Included are a lot of do-it-yourself illusions, puzzles and eye-dazzlers for anyone intrigued by the subject—and we'll promise that few readers won't be.—RFD

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DGEST

Is one girl a giant and the other a midget? Not likely, because as you see on the cover, they've switched places and their sizes have reversed. What's happened is that you're a victim of an optical illusion. The room they're in appears to be rectangular, but it's not at all. To find out about this strange room and other weird tricks your eyes play on you, see page 45. Cover photos by Bob Berger.



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SCIENCE NEWS

Vol. 66, No. 1

CONTENTS

SOLEMON MEMO	ORNITHOLOGY
Bulletins at Press Time 4 New for People	Teaching Songbirds How to Sing20
New for Industry56	PSYCHIATRY
Colleges in Action68	The Perils of Pill-popping With Mood Drugs
AGRICULTURE	
Eye in the Sky for a Hungry World 63	PSYCHOLOGY
ARCHAEOLOGY Ancient Greece—Alive and Well in South of Italy?	The Great Moon Hoax
INVENTIONS	
Micro-mini Photography	How Many Ologies Do You Know?39
	TECHNOLOGY
A Giant Step Toward Solving the Mystery of High Blood Pressure 8 Fat Folks' Hidden Secrets	Magic Carpet for All Outdoors
DEPART	MENTS

		ď	7	-					
					2	Books			

This	Month 2	Books8
Isaac	Asimov Explains74	Letters 8
Quiz		Index90

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NEWS IN BRIEF Bulletins at press time



AS APOLLO 10 WENT INTO MOON ORBIT at press time, astronauts Edwin E. Aldrin, above left, and Neil Armstrong (Apollo 11 lunar module pilot and spacecraft commander respectively) were already going through dress rehearsal for their moon landing, scheduled for July 16. They are shown above on a simulated moon surface at the Manned Spacecraft Center in Houston, Texas. Aldrin is using a scoop to collect samples of lunar soil, while Armstrong takes pictures. The Lunar Module is in the background. Their backpacks will provide oxygen, pressurization and temperature control inside their space suit environment.

A COSMIC RAY DETECTOR BENEATH THE PYRAMID AT GIZA has been at work for nearly three years trying to get an X ray type picture through the massive stones that would show where a suspected secret vault is located. No one has ever been able to find Khefren the pharaoh who built the great pile. A lot of smart people have been quessing that Khefren had himself sealed into a vault hidden far up in the peak, with his treasures heaped around him. So a few years ago, Dr. Luis Alvarez, Nobel laureate in physics whose work in cosmic rays has taken him all over the world on a wide variety of unusual and interesting jobs, figured that if he put one of his ray counters in an empty passageway underneath the great pyramid, that the bombardment pattern should reveal any hollow areas in the rock mass. Early in April Dr. Alvarez thought he had detected a hideaway. But more recently, he announced that drills failed to confirm his suspicions. He's not quitting, though. Next, he hopes to check out the flaring lower sides.

THE EARTH IS SHOOTING GREAT BURSTS OF RADIO ENERGY into space, a lot like those from the mysterious spots on Jupiter. They were spotted by the radio astronomy satellite "Daddy Longlegs," orbiting some 3,640 miles in space. The bursts seem to emanate from a region of the upper atmosphere, over a point midway between New Zealand and the Antarctic continent. No explanation for the phenomenon has been determined as yet.

THE BEST SPACECRAFT LANDING SITE ON MARS may be near a polar cap, if observations at University of Texas are correct. The total amount of atmosphere — mainly carbon dioxide — on the Red Planet changes greatly with the seasons: in the Martian fall and winter it is thin; but in the spring when the polar caps evaporate, the atmosphere becomes thick again. A spring landing near one of the caps would be ideal because spacecraft would be more easily controlled in the dense atmosphere.

XYY "CRIMINAL" GENE THEORY IS NOW DOUBTED by Canadian scientists who have just completed a survey of newborn infants. The XYY defect in males, which is supposed

July, 1969 5

to lead to antisocial behavior in adulthood, may occur as often as once in every 250 births -- far more frequently than previously estimated, says a recent issue of New England Journal of Medicine. Some scientists are now suggesting that the XYY defect's relationship with criminal behavior "...may not be as strong as has previously been implied." The survey was headed by Dr. Fred Sergovich at Victoria Hospital in London, Ontario.

A PLASTIC GELATIN VERY MUCH LIKE HUMAN FLESH promises to be a major new medical aid. The gel, which resembles Jell-O, is a soft, nonabrasive pad that acts just like human fatty tissue. It's an effective padding for artificial limbs, a bed sore-preventing cushion for paralytics and protective padding for football players and other athletes. Researchers at the University of Michigan Hospital, Ann Arbor, developed the polyvinyl gel.

SOME HEART TRANSPLANT PATIENTS BECOME PSYCHOTIC, according to a Stanford University psychiatric team. They suggest that an anti-rejection drug called "prednisone" may cause psychotic behavior such as delusions, insomnia accompanied by fear of a murder plot and a belief that the patients had received not only a new heart but also a part of the donor's personality. Psychiatrists report too, that there is in general a higher incidence of emotional problems in heart patients than in any other group of surgical patients.

TRAVELING IN AN UNDERGROUND TUBE AT 150 MPH may be the mass transportation mode of the future if engineers at Duke University, Durham, N.C., have their way. They propose that the answer to air pollution and urban congestion is to haul passengers and freight in huge cars or cylinders within an underground network of tubes. A wall of compressed air would move the cylinders at speeds well above 100 mph. The engineers say that the ride would be very comfortable -- "no bumps or rocking." And the system would be cheaper to build, they claim, than present highways.

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A giant step toward solving the mystery of HIGH

by Ruth Winter

one of making your blood boil, you had better think twice about it. There is conflicting evidence about the effect of emotions on blood pressure. In fact, for 80 percent of the 10,500,000 victims of high blood pressure in the United States today, the cause of their condition is unknown.

Blood pressure is the force exerted by the blood against the walls of the blood vessels. It is created by the pumping action of the heart. The blood normally circulates so rapidly from the heart through the blood vessels and back again that a drop of it needs less than 60 seconds to make the trip.

To determine a patient's blood pressure, physicians measure the pressure in the large artery in the upper arm. The greatest pressure, which occurs during the contraction of the heart, is known as the "systolic" and the lowest pressure, during which the heart rests, is known as the "diastolic."

The blood pressure varies from one individual to another and from time to time in the same individual. It is normally lower in children and slightly lower in women than in men. During sleep, the pressure is decreased and during exercise it is increased.

Most physicians consider an adult pressure of 135/95 (systolic pressure

is 135 and diastolic pressure is 95) suspiciously high and they agree that continued blood pressure above 150/100 calls for medical attention. Prolonged high blood pressure is known to cause damage to the walls of the smaller arteries and to frequently lead to heart disease, kidney ailments or strokes.

But there are many mysteries about high blood pressure. Victims of high blood pressure are particularly susceptible to peptic ulcers and migraine headaches. Is there a link between these diseases? Another unknown—people with high blood pressure rarely get cancer.

Doctors do know that salt adversely affects the blood pressure of "susceptible" people—persons with a family history of the ailment—but they don't know why. In fact, Dr. Lewis Dahl, senior scientist at Brookhaven National Laboratories Medical Research Center and a leading expert on the causes of hypertension maintains the addition of salt to baby foods may lead to hypertension in susceptible babies.

Licorice candy has also become another suspect food as far as causing hypertension. University of Michigan researchers reported curing a 58-year-old man of severe high blood pressure after they stopped him from eating three licorice candy bars a day.

The importance of stress is a debatable factor in hypertension. It is well known that blood pressure rises

BLOOD PRESSURE



Brookhaven National Laboratories

Emotional strain may not cause hypertension, according to Dr. Lewis Dahl of Brookhaven National Laboratories. He and technician Martha Heine are shown conducting "stress" experiments with rats. Electrical shocks caused no increase in hypertension in rats.

with excitement as the lie detector has often revealed. It has also been observed that persons who later develop hypertension have blood pressure that rises easily with emotion and stays higher longer before returning to normal. Yet, Dr. Dahl at his Brookhaven National Labora-

tory Research Center has labeled as "dubious" the idea that the stress and strain of daily living causes high blood pressure.

He and his colleagues placed rats that had been bred to develop high blood pressure in special "stress cages." They received harmless but







which regulates blood pressure by changing heart rate and output using the autonomic nervous system. The internal receiver of the stimulator (lower left in photo at left) is implanted just under the skin in the patient's chest. It is battery-powered and operates with an on-off switch. The X ray photograph above shows the position of the implanted stimulation unit with electrodes attached to carotid nerves in neck.

uncomfortable electric shocks. In one experiment, rats on a low salt diet received an average of 36 shocks a day for six months but developed no more hypertension than rats not shocked.

In a six-month crowding test where 20 rats were placed in crowded cages and 10 rats were not, the crowded rodents, whether on high or low salt diet, had slightly lower blood pressure on the average than the uncrowded ones.

On the other hand, Dr. Norman

A. Scotch did a study of the "Sociocultural Factors in the Epidemiology of Zulu Hypertension" and reported it in the American Journal of Public Health. He found that when rural residents moved to the city, they developed high blood pressure if they found the adjustment of city life difficult or impossible.

Doctors may not fully understand the causes of hypertension yet, but fortunately, they can successfully treat the majority of cases. Drugs have lowered the death rate from

high blood pressure 50 percent in the past 15 years.

Around 1953, Dr. Robert W. Wilkins of the Boston University School of Medicine became interested in reserpine, a drug extracted from the South American snake root plant. He found that it not only had a calming effect, but it decreased blood pressure as well. Although still in use today, it has been followed by many new drugs.

One of the most powerful antihypertensive drugs was developed at the Ciba Pharmaceutical Company, Summit, N. J., by Dr. Robert P. Mull and his associates in the late 1950s. They succeeded in isolating and synthesizing gaunethidine, which inhibits the release of norepinephrine, a powerful hormone produced by the adrenal gland. It causes the heart to pump harder and raises the blood pressure.

The synthetic gaunethidine was introduced in 1960 as Ismelin and is used primarily for patients with sustained high blood pressure and for malignant hypertension, a rapidly progressive form of the disease.

Another widely used class of drugs in the treatment of hypertension is the diuretic which washes excess salts and fluids from the body. One of the newer ones is Smith Kline and French's drug triamterene derived from pteridine, a substance found in the pigment of butterfly wings.

Dr. William Stanley Peart F.R.C.P., professor of medicine at St. Mary's Hospital, London, and one of the world's leading experts on high blood pressure, believes that if science understood why some drugs work with certain patients and not with others, a clue to the cause of hypertension would be found.

"If you take 100 patients and give them a particular drug, 20 will benefit from it. Now does that mean all 20 have the same type of high blood pressure? You can't be quite sure how the drug is lowering the blood pressure in those 20 people."

One of the mysteries about hypertension that intrigues Dr. Peart is that it makes atherosclerosis (fat deposits) in the arteries worse.

"This can be demonstrated by the artery to the lung. The lung artery has a pressure of about 15 degrees mercury whereas the arteries feeding the rest of the body have a pressure of 100 degrees mercury. It is normally unheard of to have an atheroma (fat plug) in the artery to the lung. If you have a situation where you raise the pressure in the artery to the lung by any disease, you begin to get atheromas. This is telling you that higher blood pressure is increasing the tendency to deposit atheromas in the blood vessels."

Diagnosis often too late

Does he believe that solving the problem of atherosclerosis or hardening of the arteries will also solve the problem of high blood pressure?

"It will solve it for some. You look in the older age group and you find narrowing of the renal artery by atherosclerosis. This contributes to high blood pressure," he says.

"The curse of high blood pressure," he says, "is that we are seeing patients too late. By the time a patient has symptoms from his hypertension, the damage has been done. This is one of the greatest arguments for an annual physical examination. We are 10, 15, 20 years too late in diagnosis. The measuring of blood

pressure should be automatic.

"There is little doubt that the effects of high blood pressure are felt less in women. In fact, in a condition, a doctor's rushing in to treat high blood pressure depends on whether it is a man or a woman. Women, for some reason, can better bear the stress of hypertension . . . that is, until menopause. Then they outnumber men in the incidence of serious hypertension."

When drugs fail to control hypertension, doctors may resort to surgery. As far back as 1927, an Italian surgeon suggested cutting a nerve near the spinal column to lower blood pressure. This nerve is still severed by surgeons today in an effort to lower stubborn high blood

pressure in some patients.

A newer operation involves the implantation of a pacemaker with the electrodes attached to nerves in the neck. When blood pressure rises or falls above a narrow range, the carotid sinus nerves tend to bring it back within the normal range. These nerves act through the autonomic nervous system to bring about appropriate changes in the heart rate, heart output and blood vessels.

When the carotid sinus is stimulated by electrical impulses, the sinus "reads" the blood pressure as being above normal and thus compensates by reducing blood pressure and

blood vessel tone.

The newest surgical procedure is designed to lower the type of blood pressure which is caused by insufficient blood supply reaching the kidneys. It is estimated that approximately one million Americans suffer from this form of hypertension.

Harry S. Goldsmith, M.D., associate member of the Sloan-Kettering

Institute for Cancer Research, devised the procedure which involves increasing the blood flow into the kidney by implanting major artery directly into this organ.

Another type of surgery to lower hypertension which Dr. Peart believes should be done is the kidney

transplant.

"There are many young patients whose blood pressure cannot be lowered by drugs. Given the facility and free choice, I would give them a kidney transplant," he said. "I know I can lower their blood pressure in two ways. The first is to put them on hemodialysis (artifical kidney machine) and the second is to transplant a kidney.

"I think it is perfectly proper to use a kidney transplant as therapy for hypertension. We haven't done it yet as such, but we have done it in a sense with patients with complete kidney failure. In complete kidney failure, blood pressure skyrockets.

"I would do kidney transplants right now for severe hypertension in young people . . . but there are just not enough kidneys available for

transplant," he concluded.

Dr. Irvine Page, a Cleveland Clinic cardiologist and editor of the physician's journal, Modern Medicine, said about hypertension in an editorial: "The past 40 years have represented singular growth period in this field. But now it is time to regroup. It is not enough merely to apply what we already know. . . . Treating this disease is still a poor substitute for preventing it."

For further reading

Long Life to You. Leo Schneider. Harcourt, Brace & World, Inc. 1968.

The perils of pill-popping with mood drugs



users is soaring. Many scientists are alarmed.

by Earl C. Gottschalk

AVID M., a breezy, aggressive young salesman, had to do a lot of flying in his work, but he had strong fears about going up in airplanes. His fears eventually increased to the point where he seriously considered giving up his high-paying job.

So David took his problem to a physician, who told him to try taking a tranquilizer tablet shortly before flight-time. The pill worked. It worked so well, in fact, that David, prescriptions in hand, soon began trying other mood-changing drugs when he felt the need.

To get "up" for important business appointments or social engagements at the end of tiring days, he began using amphetamines, which are stimulants. He also found that amphetamines helped him to combat the hangovers he got from drinking bouts with customers. To get some sleep after a hectic day, he turned to a fast-acting barbiturate "that puts

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me out in a couple minutes." On some days, he now takes up to a half-dozen assorted mood-changing pills.

David is highly enthusiastic about his new regimen. "I never have to feel tired or depressed anymore," he says. "I don't know how I ever got

along without pills."

An increasing number of doctors and social scientists don't share David's enthusiasm for psychotropic drugs, as the mood-changers are called. They label the salesman a "pill-popper." They say he is one of a growing breed of Americans who, abetted by their physicians, are indiscriminately using drugs that can become physically or psychologically addictive to some people in fairly short order and whose long-term effects are still largely unknown.

Hazards worse than LSD

Many drug experts regard psychotropics as a greater potential health hazard than hallucinogenic drugs such as LSD, mescaline and peyote or even "hard" narcotics such as heroin, cocaine and opium. Without question, hallucinogens and "hard" narcotics have more damaging effects on users, but since they can't be obtained legally in the U.S. by individuals, they are used by relatively small numbers of people. Psychotropics, on the other hand, are readily available by prescription.

Medical men are quick to point out the specific beneficial effects of the mood-changers. "Minor" tranquilizers ("major" tranquilizers are used mostly in mental hospitals to treat serious psychoses) have contributed importantly to the treatment of various neurotic disorders. Am-

phetamines are used in medically directed weight-reducing programs and in treating certain neurotic and nervous illnesses. Barbiturates are widely used to permit rest for persons who are ill or otherwise distressed.

Yet observers believe that many people have come to view psychotropic drugs as cure-alls for all sorts of problems, real or imagined, with implications that could be damaging for society as well as for the individuals involved.

"We must consider the possibility that a kind of chemical subculture, composed of persons who use compounds for purposes not originally intended, could begin to thrive in the U.S.," says Dr. James Goddard, former head of the Food and Drug Administration. Dr. Goddard fears that this group would be escapist—that instead of tackling personal and social problems realistically they would "opt out of life's difficulties through chemistry."

Dr. James B. Louria, a Cornell University medical professor and president of the New York State Council on Drug Addiction, takes an even stronger view. He says that if present trends continue, by the year 2000 "we may have a completely drug-controlled society, where a wife slips anti-grouch pills into her husband's coffee in the morning and the pharmaceutical equivalent of the liquor store sells chemicals to produce any mood from euphoria to mystic contemplation."

Several recent national surveys indicate that the use of mood-changing drugs already is widespread in the U.S. Last year some 220 million prescriptions, or about 20 percent of all those written, were for tranquilizers, amphetamines, barbiturates or re-

The "tired-wife" syndrome that occurs around age 30 often prompts the use of mood-changing drugs.

lated psychotropic drugs. National Institute of Mental Health (NIMH) studies show that nearly half of the U.S. adult population has taken a mood-changing drug at some time and that one of every four adult Americans had taken such a drug in the previous year.

In 1967, Americans spent about \$400 million to have some 84 million prescriptions for tranquilizers filled. By contrast, in 1957 only 7 percent of the persons interviewed in a national poll said they had even

heard of tranquilizers.

"Down" drugs such as tranquilizers and barbiturates outsell "up" drugs, mainly amphetamines, by about four to one in the U.S.; social scientists say that this ratio is in keeping with the fact that it is considered more socially acceptable to take pills to relax than for stimulation.

But this situation may be changing. According to NIMH, persons aged 18 through 20 use stimulants as often as tranquilizers or sedatives. "A great many young people obviously don't agree with their elders that it's bad to take drugs for pleasure, and this feeling isn't limited to so-called hippies," says Hugh J. Parry, a sociologist at George Washington University in Washington, who directed a recent NIMH study of drug users.

The typical American user of mood-changing drugs, however, isn't a hippie or even a college student. Rather, the composite portrait drawn from several recent studies is that of a suburban housewife.

Surveys show that women are about twice as likely as men to use the drugs, with the highest incidence coming among women with three or four children. Usage is higher among persons from families whose annual income is \$10,000 a year or more than among persons from lower-income families. Jews have been found to use proportionately more psychotropics than Protestants or Catholics, and whites more than blacks.

Sociologist Parry attributes many of the differences in drug use from one group to another to differences in their liquor-drinking practices. He says that strong taboos keep many women from drinking during the day, so some turn to drugs as a release from tensions. Jews traditionally drink less than Christians and thus tend to use more pills, according to Parry. On the other hand, there long has been a fairly high incidence of "escape drinking" among blacks—hence their limited use of psychotropics.

For many women, the use of mood-changing drugs begins with the "tired wife" syndrome that usually occurs around age 30. That's the way it was last year for Betty J., housewife in Westchester County near New York City. Her three children, all under five years old, drove her to distraction all day, and worries about family finances and the crying of her youngest child kept her awake many nights. Her husband was preoccupied with his job and "took next to no interest in me," Betty says.

She adds: "I felt trapped at home

all day, and I was always tired and irritable. It got so that I couldn't talk to my husband or the kids without

snapping at them."

Betty's doctor prescribed amphetamines to pick her up during the day and a sleeping pill to use at bedtime. Betty says that the pills "made a world of difference—I feel much better." She says she limits her pill-taking to three a day (two amphetamines and one sleeping pill) and believes that her need for such medication is temporary. "I'll quit when I get all the kids off to school," she says.

Psychotropic drugs are rarely harmful when taken in small amounts under a physician's supervision, even over long periods of time. Taken in excess, however, they can

have severe consequences.

Most obviously, overdoses of barbiturates or tranquilizers can prove fatal. Physicians say a dose of 15 tranquilizers usually will kill the taker. So will 10 barbiturates taken at once. Smaller amounts of both drugs can kill when taken with liquor; like the sedatives, liquor is a depressant, and the two acting together have a potent multiplier effect.

Accidental deaths from the use of tranquilizers or barbiturates are few, but persons can become physically addicted to both drugs without conscious intent. Physicians say people react differently to the drugs; a mild dose for one person can "hook" another. And when addiction occurs, withdrawal can involve the same sort of pain, delusions and convulsions usually associated with "hard" narcotics.

One psychiatrist tells of a New Jersey housewife who became ad-

dicted to tranquilizers. The woman, 50 years old at the time, began taking the pills at her doctor's suggestion when unusual tension and irritability accompanied the onset of menopause. Her prescription called for four tablets a day, a normal dosage because tranquilizers' calming effects usually last four or five hours.

However, in the case of the New Jersey woman, the effects of the tranquilizers lasted only about two hours. When they wore off, she found herself more nervous and anxious than ever. Without consulting her physician, she took to increasing her daily dosage, supplementing her supply of the drug by obtaining prescriptions from other doctors.

Craving grew worse

The tranquilizers brought her less and less relief as her craving for them increased. Soon she was taking 10 pills a day, and "her nervousness between pills had disintegrated into fits of near-hysteria," the psychiatrist says.

Her addiction was finally recognized, and the woman was hospitalized for 10 days for withdrawal. After that, several months of psychotherapy were needed before she could resume her normal activities.

Unlike tranquilizers and barbiturates, amphetamines aren't physically addictive (a user can stop taking them without uncomfortable withdrawal symptoms), nor are fatal overdoses a problem. Nevertheless, amphetamines can be psychologically addictive, according to drug experts. "Some people seem to fall in love with them," says Cornell University's Dr. Louria. "They report instant

Many doctors have been accused of being as pill-happy as their patients—they deny it.

feelings of greater alertness, sociability and excitement. Once they've tried them, they hate to give them

up."

Serious difficulties can arise when amphetamine users fail to make provisions for the build-up of fatigue that inevitably accompanies the periods of high stimulation that the drug provides. A Manhattan psychiatrist says that one of his patients lost his business as a result of an overuse of amphetamines.

The businessman was a voracious eater who was considerably overweight; on his doctor's orders, he began taking amphetamines as a reducing aid. Once on the pills, however, he found that his capacity for work was much increased. An amphetamine tablet at night enabled him to work long hours preparing for his next day's dealings with customers. Other pills during the day kept him alert for the actual negotiations. For a time, his pill-induced energy gave him an edge over his competitors.

But eventually the amphetamines' side-effects began to take their toll. The businessman became jittery and irritable and, as sometimes happens to heavy users of the drug, paranoically suspicious of others. These changes affected his judgment and led him into numerous quarrels with associates. Over a period of time, they also led him into enough bad business decisions to bring about his bankruptcy. It took hospitalization and a lengthy enforced rest to break him away from the drug.

Some observers say that the medi-

cal profession should shoulder much of the blame for the overuse of psychotropic drugs. Bernard Barber, a sociologist at Columbia University, says too many physicians "reach for whatever drugs seem to be handy" when patients confront them with ills they cannot specifically diagnose. He decries "a medical tendency toward drug fads," psychotropics being the latest manifestations, as he sees it. "Pressed for results from all sides, doctors are sometimes as pill-happy as their patients," he says.

Many physicians deny this charge. They assert that they aren't to blame if patients don't follow their instructions to use psychotropics sparingly and for brief periods. Some doctors believe that drug industry advertising has created a public demand for pills of all sorts that they are hard-pressed to contain.

"People have been given the crazy idea that they should live a tension-free life," says Dr. Edwin Roberts, senior psychiatrist at the psychiatric division of Bellevue Hospital in New York. "They are told that there is some kind of pill that will handle any sort of life situation—like Excedrin headache number 28. It's tough for doctors to deal realistically with people who have such ideas."

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ANCIENT GREECEalive and well

in south of Italy?

HEN THE MAYOR of Galliciano, mountain village in Calabria, rose to speak to the small crowd assembled for the opening of Galliciano's new-and first-road. none of the official guests understood a word he said. Townsfolk in the square, however, laughed at his jokes. He was speaking in Greek.

Galliciano is one of a half-dozen isolated villages in Calabria where Greek with an admixture of Italian and Calabrian is spoken. The others are Bova, Roccaforte, Roghudi and

Condofuri.

18

A second Greek-speaking enclave is on the Salento peninsula in Apulia (Italy's heel). One of the villages there bears the friendly name Calimera-"good day" in Greek.

Why do these Italians speak Greek? Possibly because the villages, hidden away in rugged mountain country, are the last remnants of the Greek colonization which between 800 B.C. and 500 B.C. (long before Rome amounted to anything) turned parts of Southern Italy and Sicily into Magna Graecia or Greater Greece.

Skeptics balk at this explanation. They point out that (1) the conquering Romans thoroughly latinized Italy, that (2) the dialect of these people is not recognizable as classical Greek and that (3) there were two periods of Greek influx more recent than the pre-Roman colonization. One took place between the sixth and eighth centuries A.D. when Greek-speaking Byzantium ruled parts of Italy. Yet another wave of Greeks, along with Albanians and speakers of Slavonic, arrived in the 1400s seeking refuge from the new Turkish overlords of the Balkans. Both Albanians and Slavs still have their own linguistic enclaves in Italy.

Not so, says Gerhard Rohlfs, professor at the University of Tuebingen, who has made the study of Magna Graecia his life work. He believes that some Greeks may have fled the Turks to Italy-and were soon submerged among their Italian neighbors. The Greek-speakers of

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Science Digest





American Numismatic Society

Coin of ancient Greek colony is part of recently excavated ruins in southern Italy indicating possible early (800 to 500 B.C.) Greek colonization in Italy. Note Athena's "Greek profile."

Calabria and Salento, he maintains, are the direct offspring of the early colonizers of Italy.

The fact that their language is no longer a pure classical Greek is due to the natural transmutation which occurs in every living language over the centuries. But, says Rohlfs, the speech of the mountain people of Calabria and Salento contains archaic elements "to an extent which is to be observed nowhere else in Greek-speaking territory" except one tiny patch of the Peloponnesus in Greece proper.

Rohlfs notes that for "yes" and "no" (vai and oxi in modern Greek) the Calabrian forms are manè and $u\delta\dot{c}$, in Salento $\dot{u}mme$ and $d\dot{c}ge$. He gives other specialized linguistic points. They may be found in his article in *The Classical Journal* of January 1962.

Other factors cited by Prof. Rohlfs: Although the Romans were highly successful in imposing Latin on the conquered Gauls and Iberians, they failed in the attempt whenever they came in touch with Hellenism. In Greece, Asia Minor

and Egypt, Greek proved stronger than the language of the conqueror.

A particularly striking argument is based on a religious aspect. The Albanian refugees who came to Italy in the 15th century were—and still are -staunch adherents of the Greek Orthodox faith. In contrast, the Greek-speaking hill folk of Calabria and Salento are Roman Catholics. Had they fled the Turks in the 1400s, they would have arrived in It alv as members of the Greek church: and an event as momentous as their mass conversion to the Roman faith would not have gone unrecorded had it happened as recently as the 15th century.

If these assumptions are correct, in tiny part of Magna Graecia is still alive. But what with TV, new roads and tourism, many fear it won't be for many generations longer.

The Byzantines did not appear to have come to I taly in sufficient strength to bring their language with them. They ruled Ravenna for 232 years—and Bari even longer—but there are no traces of Greek in the speech of these cities.



Teaching songbirds how to sing

An absurd idea? Not really. Songbirds are actually being taught to sing—sometimes even the wrong songs.



by Barbara Ford

THE ROARING SOUND being recorded into the square box is so loud that the laboratory assistant feeding the bird in the box

wears ear protectors. The bird itself doesn't seem to mind the noise. Perched on a bar, it accepts insects from the assistant's hand. A bird just like it awaits its turn.

"These are red-winged blackbirds about 15 days old," says Dr. Peter Marler of New York City's Rockefeller University, a private institution I i m i t e d to graduate instruction. "They were dazed for an hour or so after we put them in here, but now they seem to have adjusted themselves. The canaries don't mind at all." He opens the door to another noise-filled box and several canaries peer out. Other boxes contain canaries.

The purpose of the noisy boxes? Dr. Marler, a British born biologist, is one of a small group of scientists in this country and abroad who are investigating how birds learn to sing. In this particular test, Dr. Marler hopes to determine what kind of song the birds will sing after they are

In order to keep track of his dozens of song birds, Dr. Marler marks them with leg bands as he's doing with a red-winged blackbird. raised in a cage so noisy they can't hear themselves sing. Surgically-deafened birds serve as controls. If the experiment turns out like previous ones with surgically-deafened birds, the blackbirds and canaries will not produce a normal song.

When this crop of songbirds is mature, their songs will be recorded in a sound-proof chamber. The tape recordings will be played into a machine called the sound spectrograph, which produces a visual record of sounds (Science Digest, Nov. 1968, page 28). By looking at the record—called a sonogram or "voiceprint"—Dr. Marler will be able to see just how the song of red-winged blackbirds and canaries raised in noisy isolation compare with those of birds raised under normal conditions.

The current interest in birdsong on the part of scientists like Dr. Marler stems from the fact that songbirds are the only animal other than man that are known to *learn* to communicate with their own kind. The word *learn* is significant. Most animals communicate, but the few studies of animal communication that have been carried out indicate that such communication is instinctive. Learning seems to play little part.

Birds, too, have their instinctive sounds. A good deal of evidence indicates that bird calls, as distinguished from songs, are instinctive.

A call usually consists of just a few notes or, if longer, a series without any clear organization. A song, on the other hand, is a series of notes produced in succession and related to form a pattern. A crow will give its characteristic "caw" and a sparrow will produce a sparrow-like chirp whether or not they ever hear a mature bird of their own species calling. At the Kalbfleisch Field Station of the American Museum of Natural History, four-week-old chickadees utter their "chickadee" call even though they haven't heard an

adult chickadee since they were two days old. The only exception to the rule that calls are instinctive seems to be birds of the parrot family, research on which is meager.

Songbirds, technically called passerines, are another story. Some of these birds have been shown to be incapable of rendering a mature song characteristic of their species if they are raised in isolation. Others will pick up songs which they never sing in nature if they are exposed to alien birds or even recordings.

This will hardly come as a surprise



Photographs by Bob Combs

Dr. Peter Marler (left) plays ■ tape of ■ song produced by an isolated songbird into a sound spectrograph to produce a visual record of the sounds. Squiggly lines on sheet in foreground depict one such song. Canaries (below) raised in isolation in cages so noisy they can't hear themselves sing are transferred to this room-a more normal environment. In this place they hear the sound of their own voices as well as those of other birds for the first time in their lives. Successfully raising wild songbirds (right) from the egg requires carefully-controlled conditions, lots of patience. Dr. Wesley Lanyon and his wife feed their infant birds a basic avian diet supplemented by insects, berries and other delicacies. The birds occupy a heated nest inside temperature-controlled box.



to people who have observed passerines closely. For centuries, songbird-owners have noted that their pets will try to imitate the sounds of other birds and even musical instruments. In the 19th century, schools existed in Germany to teach bullfinches how to sing more complicated songs. During the 18th century, scores for teaching birds to imitate musical instruments were popular all over Europe. Today you can buy records to teach your canary how to sing.

But this "evidence," extensive as it is, is all subjective since it depends solely on man's ear. After World War II, however, sensitive electronic sound equipment was put on the market. One of the instruments made available was the sound spectrograph. A few enterprising scientists took young songbirds into their laboratories, recorded their songs and played the tapes into the spectrograph. After training with mature birds, the young birds' songs were again taped and put in sonogram form. The results confirmed the subjective impressions of centuries: songbirds could learn to sing.



American Museum of Natural History

In recent years, these early findings have been augmented by the results of more sophisticated experiments. Some puzzling questions about songbird learning have been answered and almost as many questions have been raised. Songbird learning, scientists have discovered,

is not simple matter.

Take, for example, the degree of learning. Not all songbirds learn to sing, and the ones that do learn pick up varying amounts depending, apparently, on the species. A former student of Dr. Marler's, Dr. James Mulligan, now at St. Louis University, has shown that song sparrows, which have a repertoire of about 15 extraordinarily complicated songs, are capable of learning at least some of them in isolation. Dr. William Thorpe of Cambridge University discovered the same ability in buntings, which have a much simpler song. The blackbird, too, can produce a perfectly normal adult song in isolation but it learns other themes when it's exposed to mature blackbirds.

The case is entirely different with birds like the white-crowned sparrow, the canary and the chaffinch. All develop songs when reared in isolation, but the songs are definitely abnormal. When these species are raised with other young of the same species, they develop an abnormal song but one that conforms remarkably with the abnormalities of their associates. Apparently these birds have to hear mature birds before they can sing a normal adult song.

The development of all songs, innate or learned, usually proceeds in the same way, spectrographic analysis shows. The first sounds made by young birds are not songs but calls. Within a month or five weeks after birth, songbirds begin the subdued warbling called "subsong." Subsong varies widely in frequency, almost as if the bird were practicing for his mature repertoire. Most female songbirds retain this subsong throughout life, although a few females do develop a mature song. But the functions of song as a mating call and a warning to rivals usually reserve it to the males. By fall, the song of birds born in the spring has evolved some distinct vocal patterns in addition to subsong. The following winter and spring, mature song appears.

Training deaf birds

This schedule means that at least several months normally elapse between the time when a young bird hears a song and the time when he actually sings it himself. In the nightingale, the lapse may be as long as eight months. What makes the young bird remember the song he has heard? Dr. Marler thinks that songbirds develop what he calls an "auditory template," or model, when they learn a song. Later, their own vocalizing allows them to match their songs with the model. For proof, he points to work with deafened birds.

"If a bird is deafened after it has been trained to normal song but before it has itself begun to sing, it develops a song pattern that lacks any sign that the training was effective and that is even more abnormal than the song of an untrained bird," he says. "The sound is almost mechanical, or insect-like."

Birds deafened after they have begun to sing themselves have a more normal song, the degree of normality depending on how long the bird has been allowed to sing. Once mature song appears, it is usually fixed for life—although, as usual, there are exceptions. Thrushes, for example, seem to change their songs substantially throughout their lives. Chaffinches may omit a phrase in later years.

The extent of a bird's repertoire doesn't vary, however. If it begins singing six songs in late winter or early spring of its first year, it will continue to sing six songs throughout its life span. The extent of the repertoire seems to be set by the species, with a few singing as many as 50 different songs. In this connection, Dr. Wesley Lanyon of the American Museum of Natural History, has done some interesting work with hybrid meadow larks. He found that these hybrids develop a repertoire that includes more songs than those of either of its parents and that only one of the songs is an imitation of the male parent.

One of the most fascinating unanswered questions about birdsong learning concerns exactly when learning begins in those species that do learn. Does learning begin in the egg? In the first few days after birth? Or later? The few experiments conducted along these lines seem to indicate that songbirds do not learn songs in the first week of life. But the evidence is far from conclusive, because hardly anyone has succeeded in raising wild songbirds from the egg in a laboratory. Unlike calling birds, songbirds are born in an extremely helpless condition and even large amounts of tender loving care under rigidly controlled conditions usually fail to keep the infant songsters alive.

One of the few scientists who has succeeded in raising wild songbirds

Scientists can't find out when songbirds learn to sing until they can raise them from the egg.

from the egg is Dr. Lanyon, who is an ornithologist. In the past two years he and his wife, who serves as his assistant, have reared blue jays, house wrens, eastern meadowlarks and crested flycatchers from the egg stage. The jays and wrens, both nonsongbirds, have been released, but the meadowlarks and flycatchers are serving as subjects in a number of learning studies. The Lanyons' laboratory is located at Huntington, Long Island, on the grounds of the Kalbfleisch Field Station, which is operated by the American Museum of Natural History. The station is a rolling tract of land with a large pond and a number of buildings.

"My wife and I have been working on raising wild birds for 16 years, and we now feel we have the answer," says Dr. Lanyon. The secret, he explains, lies in two factors: nest and diet. Almost all scientists who raise wild birds use large, sound-proof, temperature-controlled boxes, but the Lanyons go a step further and provide a temperature-controlled nest inside the temperature-controlled box. Actually, the nest is the standard spun glass heating mantel used to heat inflammable materials in laboratories.

"We heat the nest from below—the birds are in the nest," he says, opening the front of a box and displaying four minute blue-winged warblers in side the bowl-shaped "nest." The birds open their beaks hungrily. "We feed them the basic Bronx Zoo avian diet, but we add all sorts of things," says Mrs. Lanyon. A tray beside the box contains a

number of ingredients, of which berries are the only recognizable item. She mixes the ingredients together and spoons the mixture into the beaks.

"We've suffered more in raising birds like these than we did raising each of our children," says Dr. Lanyon. "But now we've refined our techniques so that what used to be very difficult is no problem at all."

It's still a problem for most researchers, though. Dr. Marler and Dr. Mulligan have both tried to raise wild songbirds from the egg with canary foster mothers. "I haven't had any success, but Jim raised few birds when we were both at the University of California at Berkeley," says Dr. Marler. Dr. Mulligan is continuing this method at St. Louis University, but Dr. Marler is switching back to hand rearing with "a few new ideas."

Raising songbirds from the egg will probably answer one nagging question on passerine learning, but there are still plenty of other mysteries to be unraveled. Why do some young songbirds learn much from mature individuals, others little or nothing? When does learning stop? And how does a bird know which bird in a forest of birds to imitate? Answering these and other questions should keep students of songbird learning busy with tapes and sonograms for years to come.

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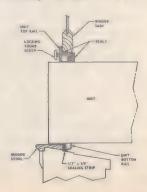
NEW FOR PEOPLE



Miniature electronic organ called "Stylophone" is no bigger than a transistor radio, but it's a real musical instrument, not a toy. Invented by Briton Ted Coleman and marketed in the U.S. by American Xylophone Co., Chicago, the instrument has a keyboard which is played by touching it with an electronic stylusno keys are depressed. The makers claim that even the most unmusical of people can learn to play it after only a few minutes of practice. It is even possible to connect the instrument to a home hi-fi amplifier and then play it through stereo speakers.

A room-to-room air conditioner that can be toted around and slipped into almost any double-hung window without need of braces and brackets is this season's adventure in "portable" coolth. It's as portable as anything weighing some eighty pounds can be portable (which means that with only the help of your wife or 12 year old, it can be Jockeyed around from room to room as required, plugged into a 115-volt outlet and away you go.) This latest in relatively lightweight air conditioners, comes in 5-, 6- and 8,000 BTUH models and is really for smaller rooms, like nurseries, bedrooms and dens measuring up to about 12 x 12 feet in size. But it will even drop the temperature several points in a larger room if things get insufferable. The one shown below left is a two-speed model manufactured by Chrysler Airtemp. The diagram at right shows how it fits into and is braced by the window framing itself with minimal "keepers." Blower is cushion mounted and thermal insulation prevents sweating. It's called "The Sleeper."







Jog right in your home, office or hotel room on the new "Pace-Setter" by Reynolds Aluminum, Richmond, Va. All you do is jog on a treadmill while grasping the handlebars. Bad weather need never interrupt your jogging program again. You can get in several miles of vigorous jogging every day by making use of those spare moments that would otherwise just be wasted. Pace-Setter is light enough to be carried with you anywhere, and it's sturdy enough to withstand years of the most enthusiastic jogging. It even has a built-in pedometer so you can measure how far you have jogged after each day's workout.

Take your best oral hygiene habits along with you this year when you go camping. You can now buy a Water Pik (left) that is battery-powered. Water Pik Cordless by Aqua Tec, a Teledyne Company, cleans gingival margin—

place the toothbrush often misses—by gently flushing out loose debris and food particles with water stream for a cleaner mouth and healthier teeth. Device comes with simulated black alligator case the size of small purse.





You can test your own home water supply for invisible hardness with me free test kit from Culligan, Inc., Northbrook, III. All you do is quickly dip . chemically-treated paper tab into glass of water from any faucet, as shown at left. Remove tab immediately, holding it vertically. Dark gray bands will turn pink or purple if your water is hard. A simple chart enables you to determine the approximate cost of softening it. What is hard water? It's merely water into which natural minerals have dissolved. Water softeners remove hardness minerals to make your soap and detergents more effective and keep cleaning costs down.

NEWS IN BRIEF Science Month

Black children choose white dolls

B LACK YOUNGSTERS who are asked to select a black or white doll from two dolls presented to them usually choose the white one, according to a recent New Jersey study described in the Journal of Social Issues. Thirty years ago in a similar test, more black children chose black dolls. The young blacks' responses are much like those of white youngsters, who also prefer white dolls.

The test set-up for the 341 youngsters, who ranged in age from three to eight, was simple. Each child was shown two puppets identical except for skin and hair color and asked four questions at random:

Which puppet is the nice puppet? Which puppet looks bad?

Which puppet would you like to play with?

Which puppet is the nice color?

The children responded by pointing. Black experimenters tested blacks and whites tested whites.

Both blacks and whites clearly preferred the white puppets to a statistically significant degree, the re-



Face pressed to store window, child strains to get a better look at dolls. Psychologists suggest that black children choose white dolls because of their feelings of inferiority.

sults show. Middle-class blacks tended to like white puppets even more than lower-class blacks. The question that elicited the most white preference among these advantaged black youngsters was the "nice puppet" query. White children showed little class difference in their choices.

On all four items, black boys favored the white puppet more than black girls. So did white boys as contrasted to white girls. Among the black children, the differences tended to increase with age, with boys preferring white puppets to a greater extent as they grew older and girls preferring them less.

The 1939 study, on which the current study is based, showed a little less preference for white puppets among black children on three of the four questions. In the new study, more black children—most of them seven to eight years old—preferred

to play with the black puppets than in the old study.

The two psychologists who conducted the research, Steven R. Asher and Vernon L. Allen of the University of Wisconsin, suggest that the enhanced status of the black today may actually increase his feelings of inferiority because he is compared more frequently with whites. The older black children in the study who chose to play with blacks instead of whites may be avoiding threatening social comparisons.

Since black males are more likely

to be aware of their relatively inferior social position than females, they choose white puppets even more than black females, Asher and Allen add.

Although it's not statistically significant, one particularly interesting fact that emerged from the study is that two children from Black Muslim homes chose black puppets over white. Does the rejection of social comparison with whites, as black militants urge, result in a more positive race and individual pride for blacks?

Sleeping on air

A bed designed to help treat bedsores and burns is also putting insomniacs to sleep and possibly even changing the content of dreams. Called the "fluidized bed," it consists of sea of tiny glass beads, each about as large as a grain of sand, that are supported by warm air.

Milton Roy Company, the de-

signer and manufacturer, is testing one such bed at the Medical College of the University of South Carolina where, doctors report, it not only cuts the time needed to heal bedsores but also induces a peaceful, drugless sleep in insomniacs. One such insomniac, who hadn't had a real night's sleep in over 20 years, was able to sleep deeply without terrifying

Blurred photo below can be cleared up to appear like this man's face because of a process called "photo-restoration." Developed at Scripps Institution of Oceanography, process involves a machine which scans picture and converts it to thousands of dots. Information is then fed into IBM computer which corrects image and projects it onto cathode ray tube.









Aged elephant groping above is blind and can't find food. Younger elephant comes to his aid and begins feeding him. This is unheard of behavior in most other animals-but fairly common among elephants. Most other species drive the old or sick out of the herd or kill them.

dreams that had plagued him since he had participated in the Normandy invasion in 1944.

A psychiatrist at the Medical College reports that mental patients treated in the bed experienced deep restful sleep with apparent change in dream content and percentage. More "fluidized beds" will go to other research institutions, but don't sign up for your model yet-they cost between \$7,000 and \$10,000 in their present form.

Stewardesses: tears inside

Those high-flying stewardesses with the gleaming smiles may actually be feeling mighty low, says a French psychiatrist who works for Air France. Eighty percent of the stewardesses whom Dr. Claude J. Blanc examined in the last five years had emotional problems that found expression in depressions or neuroses. Conflicts in private life often precipitated the psychic syndrome, leading the French investigator to believe that the stresses of their job work against stewardesses with private problems. The stresses include a

career that is "merely an intermediary stage in their existence, since the regulations limit their period of activity," explains Dr. Blanc.

Safe in a quake

The actual moving of the ground in an earthquake seldom causes death or injury, says the Department of the Interior. Collapsing walls, falling debris, flying glass, fires and fallen power lines do most of the damage, along with the landslides and giant ocean waves sometimes triggered by a quake. If you're inside in a quake, the Department suggests staying away from windows, mirrors and chimneys. Crawl under a table, desk or bed if the shaking is severe. If you're outside, try to avoid high buildings, walls, power poles and other objects that might fall.

Animal life on Jupiter?

Animal life may have evolved on other planets in our solar system, according to scientists at NASA's Ames Research Center in California. They applied an electrical charge to

a mixture of methane and ammonia simulating the atmosphere of Jupiter and produced hydrogen-cyanide and cyanogen. These products are the chemical precursors of amino acids which are the building blocks of proteins, a major component of animal life.

In one experiment, the Ames group applied an electrical charge to a mixture of methane, ammonia and water for just 24 hours to come up with chains of amino acids called polypeptides that are almost as long as protein molecules. The same mixture of water and gases is believed to have made up the earth's primordial atmosphere.

The Ames experiments "lend support" to the theories of the existence of extraterrestrial life and the chemical evolution of life, says Dr. Cyril Ponnamperuma, chief of the chemical evaluation branch in the exobiology division at Ames. The speedy production of polypeptides indicates that chains of amino acids could have formed quickly instead of in the half-a-billion years that had been estimated.

A number of energy sources—ultraviolet light, electrical discharges, radioactivity, heat—could have supplied the "spark" to set off the life-producing reaction, Dr. Ponnamperuma adds. The Ames researchers tried them all, producing different kinds of building blocks in each case. The energy sources were directed against a pattern of circulating methane and ammonia gases and water vapor like that thought to have prevailed on the ancient earth.

In one of the earliest Ames experiments, an electron beam turned on the circulating gases produced adenine, the single most important biological compound. It's found in both DNA and RNA, the nucleic acids that determine heredity and bodily development.

Jolly is "happy" everywhere

To a pre-literate inhabitant of Borneo, a photograph of a happy face apparently looks as much like happy face as it does to U.S. college student. A new study described in Science indicates that facial expressions cross cultural lines from literate to pre-literate societies. The most widely recognized expressions are happiness, anger and fear, followed by disgust, surprise and sadness.

The groups tested came from the U.S., Brazil, Japan, New Guinea and Borneo. In the U.S., Brazil and Japan, college freshmen viewed 30 carefully-chosen slides that were flashed on a screen for 20 seconds

Portable bacterial isolation ward litter will protect patients with contaglous diseases or those susceptible to outside contamination or infection. Built by Chrysler, inflatable sheath, made of fire-retardant plastic, will be used aboard military air transports in the near future.



each. The pre-literate Fore people of New Guinea and Sadong of Borneo inspected prints of the same photographs one at a time. Subjects chose a word describing each expression from a list of six provided. Since the pidgin spoken by the Fores has no words for disgust or surprise, phrases like "looking at something which stinks" and "looking at something new" had to be used.

Researchers selected the photographs to display pure emotions uncomplicated by cues to more than one emotion and "display rules"—learned procedures for intensifying, minimizing or otherwise managing expressions. They think that confusing cues and display rules are responsible for the failure of earlier studies of facial expressions to show cultural transfer. The 30 faces chosen were all Caucasian, but Melanesian faces were also shown to the Fores, with similar results to those obtained with Caucasians.

Life begins at 100

The Southwest Research Center recently listed some problems that might occur if, as Dr. C. W. Hall of its staff predicts, we should ever live to be 200 or 300 thanks to medical research. Retirement age-will we retire at, say, 175, thus aggravating the unemployment situation? Insurance-will companies invest principal for as long as two centuries or more to give everyone a 60-year paid up life policy? Food and space -will old people (150 years and more) be shunted off to another planet for compulsory retirement to give their children a better standard of living? Prison sentences—should longevity be encouraged in prisoners serving life terms? The younger generation—how will a 200-year-old who had his children at 25 ever remember the names of all his grand-children?

Science tid-bits

The future used to belong strictly to the crystal-ball gazers, but that was before the advent of a new (1966) organization called the World Future Society. Dedicated to the serious study of the future, the Washington, D.C.-based society already has 3,000 members, including a number of respected scientific names. A recent issue of *The Futurist*, the society's magazine, made predictions about the years to come:

The writing of dates may change in the next decade. For example, July 1, 1969, would become 1969 July 1, to standardize data for electronic computers. The computer prefers year/month/day sequence, which corresponds to the hour/minute/second notation of time. Such a system is already in use by many European countries.

Full-size cities may be floated in U.S. harbors. Buckminister Fuller has already built a model of such a city, which could be strung together in a number of modules to accommodate up to 125,000 people (see Sea City, Science Digest, Dec. 1968). One advantage to floating cities: you can tow the city to another site.

Hippie attitudes may become more common. The idea of work as a duty is on the way out in a society where only a quarter of the work force will soon be needed to produce all society needs. Institutions will soon find it harder to pay the premium for unpleasant work.



Some people call synthetic turf "funny-grass," others merely "the rug"—and they're using it for everything from back yards to football fields like this one at University of Tennessee.

by H. R. Whitaker

ITHIN HOURS of the first starting gun of the 19th Olympic Games at Mexico City last October 12, records began falling like autumn leaves. By sunset of October 20, closing day for the greatest track and field meet in history, 15 world records and 23 Olympic marks were broken, several by fantastic margins.

There were all sorts of theories to explain the rash of unprecedented

performances. It was known that the competitors had been conditioned to exceptional sharpness. It was also known that black athletes, who set a majority of the records, were greatly spurred by pride in race; and that the altitude (Mexico City is more than a mile high) appreciably lowered atmospheric resistance. But there was also speculation—of particular interest to track and field competitors the world over—that the surface on which the athletes had performed



"Chemgrass," brand name for Monsanto's version of synthetic turf, is being used to carpet a traffic island (above) in Cincinnati and poolside lounge in Palm Springs, Calif.



may have been a decisive factor in the record-setting binge. And there was ample reason to think so.

The six Olympic tracks, and all runways, circles and aprons for field events, were topped with a specially compounded resin developed in 1961 by the 3M (Minnesota Mining & Manufacturing) Company of St. Paul. Originally intended as a surface for harness racing, Tartan Brand Surfacing had already earned a name for itself as a "fast track."

Since its first collegiate installation at Macalester College in 1963, record breaking on the new topping has become routine. At West Point, Track Coach Carleton R. Crowell reports that since synthetic tracks were installed in the U.S. Military Academy fieldhouse, "there has been considerable improvement in the times turned in by our athletes in the 60-yard dash, the high hurdles and middle-distance events." Similar improved times on synthetic surfacing have been recorded at the University of Tennessee, the University of Houston and Bowling Green University. A dash man who competed in last October's Olympics has mentioned the invaluable psychological effect on him of knowing he was running on a "sure-footing" track surface.

There is no quick or easy way to install a synthetic track. The laying of a single 440-yard outdoor oval requires several weeks of carefully supervised work. The operation begins with the leveling-off of a 12-inch bed of subgrade soil, over which gravel or crushed rock is then spread to a uniform 6-inch depth. On top of this layer, a final 21/2-inch base of asphaltic concrete is rolled smooth. When the asphalt has hardened, the liquid resin is slowly poured until it has reached an even thickness of 1/2 inch. In color and texture, the solidified surface resembles the sole of tennis shoe, except that it is much denser and tougher. Fieldhouse installations are usually laid over 6 to 8 inches of asphaltic concrete. Gymnasium installations ordinarily require only a thin (1/2- to 1-inch) layer of plywood.

The new synthetic surfacing is much more than a "fast" track; it is in fact a multiple prodigy that has amazed its own most enthusiastic

promoters for a number of reasons, one of which is its versatility. In addition to its rapid development as the "track of the future," the new surfacing is widely used to convert the floors of school and municipal fieldhouses into all-purpose gymnasiums. on playgrounds and ship decks, in hallways and locker rooms, as flooring for veterinary barns and for truck beds. Because of limited space. urban-located Portland State College used synthetic surfacing to turn the roof of its physical education building into an all-purpose recreational area with four tennis courts, a running track and large areas for other intramural contests.

The new material has proved its durability many times over. The Meadows harness track has lasted six years without major repairs or replacement of material, the Belmont track, five years. Of half a dozen colleges that have used synthetic surfacing on indoor and outdoor tracks for at least two years, not one has been faced with a repair bill due to deterioration of material.

Spectacular as its performance has been thus far, the synthetic track has received but a fraction of the publicity lavished on subsequently developed artificial turfs and grasses that promise to revolutionize virtually the entire range of recreational surfaces. Monsanto alone produces eight variations of a carpet-like topping—usually bright green, although it is available in other colors—that may be used to surface playgrounds, golf tees and greens, lawns, tennis courts, field houses, poolsides and playing fields for football and baseball.

To date, the fair-haired child of the funny-grass family has unquestionably been Monsanto's Stadium

Surface, a half-inch of polyesterbacked nylon pile bonded to a halfinch of energy absorbent padding, and better known to sports buffs as AstroTurf. In 1968, the 3M Company entered the competition with a similar carpet known commercially as Tartan Turf. Except for fractional differences in thickness, the graduated bases for both turfs are identical with the bases on which synthetic track surfaces are laid. Both are laid cross-wise, in strips. Astro-Turf is secured to its asphalt base by a special bonding agent and is tucked under at the edges, bed-sheet style. Tartan Turf's energy-absorbent pad, which is wet-poured, bonds itself both to the asphalt below and to the carpet backing above.

'The rug' shows its versatility

Originally installed as a substitute for the natural grass that would not grow beneath the sunlight-filtering canopy of Houston's Astrodome, the rug (as Houston students call it) did not begin to demonstrate its real virtuosity until the football season of 1967 had ended, and the reports began coming in from recent outdoor installations at various colleges. Among other schools reacting favorably to tailored turf was the University of Washington, which frequently plays its late-season games in deluges of rain. Since there are no mud puddles on artificial turf, Washington players were able to leave the field at the end of a rainy afternoon wet but clean. At Boston University, the athletic department discovered last December that artificial turf had reduced maintenance costs by 70 percent, laundry costs by more than half. As had been the case with synthetic track surfacing, the turfs were proving themselves both durable and weatherproof. Functionally, they were in as good shape at the end of the season as they had been at the

beginning.

But by far the most widely heralded feature of artificial turf has been its increasingly obvious capacity to reduce drastically knee and ankle injuries to football players. Such injuries constitute a very real Sword of Damocles that hangs over the head of every football coach in the nation, every fall, from September to December. Knee injuries alone cost professional football an estimated \$500,000 every season; while at subprofessional levels, some 50,000 of the nation's young footballers have to submit to surgery each autumn for knee and ankle injuries incurred during games or practice sessions. In one six-day period last November, five of the best known football players in the U.S. were put out of action for the remainder of the season by

knee injuries suffered on natural Casualty reports to date by schools using artificial turf have been encouraging. A survey of the 1966-67 football seasons at Houston, Indiana State and at Seattle's Memorial Stadium showed that in the course of 76 games and 89 practice sessions, only two serious knee injuries had occurred-neither of the two turf-related. On natural grass, the total would have been nine. There were no ankle injuries other than minor sprains. At the end of the 1968 season, its first on artificial turf, the University of Wisconsin found it had suffered one-third fewer knee and ankle injuries than in 1967.

Although the funny grass business

as a whole flourished during the late fall and winter of 1968-69, enthusiasm for stadium turf flagged noticeably as flaws began to appear. Midway through the 1968 football season, dark spots began to appear on the University of Tennessee's artificial turf, like a siege of synthetic acne. Prompt diagnosis by a hastily summoned manufacturer's representative disclosed that the predominant green fibres of the turf had suffered extensive breakage where play had been heavy-but that the black fibres interwoven to enhance the illusion of natural grass, had remained largely intact. In short, the turf had not held up the way it had been expected to hold up, chiefly because of the low denier count (fiber weight) that makes nylon fibres peculiarly susceptible to ultraviolet rays. When promised replacement is made this summer, the turf of Nevland Stadium will have fewer black fibres and a denier count considerably higher than that of the old turf.

Numerous low-keyed complaints about skinburns that were incurred on artificial turf haven't caused a great deal of worry. The consensus of coaches and trainers seems to be that skinburns are part of playing football on funny grass, and should be treated just as any other abrasion is treated—promptly and without undue comment.

At Indiana State, which readily admits it has suffered fewer knee and ankle injuries on artificial turf, trainers last fall nevertheless discovered a "marked increase" in hand and wrist injuries on the home field. While this is an isolated complaint, it is one more indication that all is not yet roses in the artificial turf business—that there are bugs to be worked out.

Funny-grass may even make those "keep-off-the-grass" signs in parks obsolete.

Synthetic surfacing of whatever sort will be a special blessing to metropolitan areas. An artificially surfaced municipal field such as Atwood Stadium in Flint, Mich., will be capable of bearing continuous heavy traffic in the form of football. baseball and intramural contests played by a dozen or more schools, plus band practices, ROTC drills and periodic outdoor shows and other public gatherings. For many urban sections, synthetic surfacing will also possess built-in incremental value. "By surfacing already available ground, a city school can save up to a quarter of a million dollars on new lots that are being priced further and further out of reach," declares Ward Overall, Monsanto marketing specialist. "By so doing, the school increases the value of property that otherwise might have deteriorated to nothing. Today, you've got to get maximum use out of every square foot of city ground."

The makers of artificial recreational surfaces are still improvising. Some years ago, there was experimentation with a bright green carpeting material (forerunner of the piling for today's artificial turf) that caught the public eye briefly, then disappeared. Today, a much improved development of that first "rug," called Chemgrass, is in production at the St. Louis laboratories of Monsanto. Designed for landscaping, Chemgrass, though basically similar to other turfs, has distinctive features. Its inch-high pile is of polyolefin material, rather than of nylon. The olive-green blades are much larger and duller than the fibres of golf, poolside or stadium turf, but at a distance they look much more like natural grass. Because it will invade the seed, sod and fertilizer businesses, Chemgrass is competitively priced. Where different types of AstroTurf vary in price per roll, from \$1.50 to \$3 per square foot, Chemgrass costs the customer only 45 to 75 cents, depending on the quantity ordered. And since no expensive subsurfacing is involved, the installation cost is less than that of stadium turf.

Because it is a very recent development, the future of the synthetic surfacing business cannot as vet be accurately projected. Such a projection is probably not even necessary; the industry already knows all it needs to know, for a starter—that its products have caught the public imagination and have proved their potential value to those who will be using those products tomorrow. As for the effect on the landscaping business of Chemgrass, one thing is certain: For the home or school or industrial plant that dresses up its premises with artificial grass, there will no longer be any need for the immemorial sign that reads: KEEP OFF THE GRASS. If there is a sign at all, its legend may well be: HAVE A WALK ON OUR LAWN-THE TREAT'S ON US!

For further reading

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Is yours the special kind of mind that has to know...

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... that the world's smallest monkeys—pigmy marmosets—are the size of mice, weigh a few ounces, are talkative, snippy.

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How many 'ologies do you know?

by H. S. Tucker

Expanding sciences and studies of various things are ever adding to the more than 200 "ologies" in our language. For example, did you know that one studies nothing but finger rings? It's dactyliology! Can you come up with the "ology" for each of these 30?

Science or study of:

1.	man
	antiquities
3.	structure of fruits and seeds
4.	animals in existence now
	colors
6.	decline of an organism after maturity
7.	committees
	cosmetics
	character of the universe
10.	skulls
11.	effects of low temperatures on life
	trees
	devil lore
	wines
	senses
	origin of races
	possible life outside the earth
	handwriting
	fossil footprints
	fish
	dust in the air
	waves
	lakes and ponds
	museum objects
	muscles
	ants
	bird nests
	dreams
	things dug from the earth
	smells

The great moon hoax

The moon people flew on bat wings, had furry bodies and faces like apes. They I i v e d in mysterious gardens of feathers, played on white beaches and sapphire hills—or so the New York Sun claimed in 1856. Richard Locke, editor, fabricated the whole story and plunged much of the western world into chaos.



by John Cottrell

A LL DAY LONG, excited crowds had besieged the dingy offices of the New York Sun. Now it was midnight and they still stood in thousands, more clamorous than ever.

But their vigil was hopeless. For once, neither money nor influence could secure a copy of the brash New York penny newspaper. The entire print of the sensational issue dated August 25, 1856, had been sold out since noon.

That morning's explosive banner headline had plunged the city into a ferment of speculation, curiosity and alarm. "GREAT ASTRONOMICAL DISCOVERIES," it announced, "lately made by Sir John Herschel, LL.D., F.R.S. at the Cape of Good Hope."

The news that followed could hardly have been more stupendous. There was now known to be life on the moon, the newspaper informed its breathless readers. Sir John Herschel, the famous English astronomer, had observed it recently through a powerful new 288-inch telescope, while charting the southern skies.

A full report of his amazing discovery, it was explained, had already been contributed to the *Edinburgh Journal of Science* by one of Her-



Illustrations Bettman Archive Lunar animals and men such as these were reported to exist in the fabulous moon gardens.

schel's party, Dr. Andrew Grant. The Sun had acquired exclusive rights to reprint the disclosures in a series of seven daily articles.

The first installment, while not claiming explicitly that living things had been observed on the moon, hinted tantalizingly that animal life existed there. It also described graphically a strange world of craters, mountains, rivers, forests and lush vegetation supposed to have been seen through the super-telescope.

Herschel's startling achievement, the Sun reported, had been made possible by "a transfusion of artificial light through the focal object of vision."

As far as puzzled American astronomers could determine, it apparently meant that he had found some way of reinforcing the image seen through his telescope by a light-source in the observatory itself.

It must be true, millions of Americans felt. Astounding and incredible though it sounded, there could be no doubting the reputation or integrity of Herschel and his father Sir William Herschel as the most celebrated astronomers of their age.

Between them these two had already made many important discoveries through powerful telescopes; Sir William had discovered the planet Uranus and hundreds of new stars.



Blue goat-like animals, miniature zebra and lunar bison were supposed to have been sighted by Sir John Herschel at his observatory in South Africa. When Sir John heard about the hoax, he joined the world in metaty laugh.

Who would be more likely than his son to find life on the moon? With bated breath, New York awaited the second day's revelations. They proved no disappointment.

At exactly 9:30 p.m. on January 10, 1856, the Sun's readers learned, Herschel and Grant had succeeded in focusing their great 14,826-pound lens precisely on the moon's surface.

They saw romantic mountains, the Sun said; a blue inland sea with brilliant white beaches and green marble rocks; the feathery foliage of unknown trees; ranges of hills glistening as if encrusted with sapphires, rubies and amethysts.

They saw groups of great claretcolored obelisks and pyramids; verdant creeping foliage; dark red flowers like giant rose-poppies growing in the lunar cornfields.

This appetizing scene-setter left the New York public avid for more. Interest grew to near-hysteria and the huge crowds became daily dawn-to-dusk fixtures outside the offices of the *Sun*. The newspaper's presses ran continuously to meet soaring demand and printers began to collapse exhausted.

The lofty New York Times, no longer able to ignore the new discoveries, hailed them as "both probable and plausible." The New Yorker believed they had "created a new era in astronomy and science generally."

The stunning climax was yet to come. The next installments described forests of oak-like trees with broad, glossy leaves; and, in the shade of these woods, "continuous herds of brown quadrupeds, having all the external characteristics of the bison."

Herschel, it seemed, had also sighted other creatures through the great lens that were described in convincing scientific detail. He had seen bluish goat-like animals with single horns wandering through the Utopian woods and pastures of the moon; miniature zebra; and "a strange amphibious creature of a

spherical form, rolling with great velocity across a pebbly beach."

He had observed flocks of white and red birds on the wing. In one region alone, 38 different species of trees and twice that number of lunar plants were said to have been classified.

By now the lunar discoveries were creating a major sensation throughout the eastern cities of America. A professor of mathematics in the University of Virginia traveled from Norfolk to inspect the original reports from Edinburgh. He did not see them, but nevertheless declared in print that he had no doubt whatsoever about their truth.

Scientists from Baltimore, Philadelphia and Boston arrived in New York by stagecoach to follow the story as it left the Sun's presses.

At last, when the suspense had grown almost unbearable, the serial that held America spellbound reached its high point on August 28.

The most amazing of all the astronomers' discoveries was now revealed: the existence of lunar batmen.

These were said to have been seen descending with a slow, even motion from cliffs and alighting upon a plain. "We counted three parties of these creatures," the report said. "Certainly they were like human beings....

"They averaged four feet in height, were covered, except on the face, with short and glossy coppercolored hair, and had wings composed of a thin membrane.

"The face, which was of a yellowish flesh color, was a slight improvement upon that of a large orangutan, being much more open and intelligent in its expression. The mouth, however, was very prominent, though somewhat relieved by thick beard on the lower jaw. . . ."

These lunar bat-men were said to have been observed not only flying but in conversation, bathing and eating yellow fruit with uncouth voracity near a temple.

Finally, "a very superior species" of winged Lunarian was sighted: "of infinitely greater personal beauty, and in our eyes scarcely less lovely than the general representations of a n g e l s by the more imaginative school of painters."

Americans by the million had swallowed these astonishing stories whole. In Massachusetts, a women's club wrote to Herschel asking how they could get in touch with the lunar bat-men to convert them to Christianity.

A hard core of scientists, however, clung to their skepticism. For them, stories of such a telescope stretched credulity too far. They were more interested in a footnote to the Sun's articles, explaining that 40 pages of illustrative and mathematical notes were available but were not being reprinted.

When a committee of Yale University professors turned up at the Sun's offices demanding to inspect these notes, and were told that they could not be seen, suspicion spread wider.

The Sun, meanwhile, had been transformed within one golden week from a precariously struggling venture to the biggest-selling newspaper in the world. The now-famous articles were being translated and reprinted in capitals throughout Europe.

But doubts were mounting. In Paris, the French Academy of Science debated the discoveries bitterly and denounced them as "utterly incredible."

Then a rival New York newspaper discovered gleefully that the Edinburgh Journal of Science did not exist. Soon afterwards the English editor of the Sun, 28-year-old Richard Locke, blew the whole affair sky-high by confiding indiscreetly to a reporter of the hostile Journal of Commerce that he had invented every word of the lunar story.

The truth was that Locke had been driven to this desperate extreme by the threat of his paper's owner, Moses Y. Beach, to fire him or even to cease publication unless circula-

tion was increased.

He had modeled his entirely imaginative account on a fanciful short story by his friend Edgar Allan Poe. He had hoped to get away with it by a combination of clever presentation, scientific verisimilitude—and Herschel's absence.

When Locke coolly published in



the Sun, on September 16, an admission and even a defense of the Great Moon Hoax, the wraps were off the most successful practical joke of all time.

He had merely intended, he explained, to ridicule those astronomers who still believed the moon to be inhabited. Day by day, it now transpired, he had stood secretly among the crowds outside his office, deciding what they wanted to read next day and then returning to his desk to write it.

Strangely, Locke's career emerged unharmed and even enhanced; he was even praised as a brilliant and inventive writer. His articles, reprinted in a small book as *The Celebrated Moon Story*, sold 60,000 copies within a few days and made him a lot of money.

The eruption of the scandal, and the relegation of lunar bat-men to the realms of science-fiction, left America's believing millions disillusioned and acutely embarrassed. Finally, they joined the rest of the world laughing at themselves.

Herschel laughed heartily, to o, when the full fantastic story reached him in his remote observatory many miles from Capetown, South Africa. He saw the joke better than most; the reflector on his telescope measured not 288 inches but just 18.

"Surely," he asked incredulously, "no person in his senses could have taken a word of it seriously?"

Nobody ever counted the number of learned professors set blushing by his question. ■

For further reading
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SCIENCE DIGEST SPECIAL



Prism-wearing subject in Charles Harris' laboratory reaches out to touch target but points way to the right of it. He hasn't yet adapted to the prisms, which displace vision to the right.

OPTICAL ILLUSIONS: weird tricks your eyes play on you

by Barbara Ford

In Lewis Carroll's classic tale, Through the Looking Glass, Alice enters a turned-around world after walking through her mirror. When she reaches for an object, she has to extend her arm in the opposite direction to grasp it. When she wants to walk left, she has to walk right. Sometimes she feels like she's not getting anywhere at all. I found out how Alice felt, in a weird illusion laboratory presided over by Dr. Charles Harris for Bell Telephone Laboratories in Murray Hill, N.J.

"These are mirror reversal lenses,"

Dr. Harris told me, holding out a pair of goggles into which two wedge-shaped prisms had been taped. I put them on and looked around. Everything seemed normal—or did it? "Look at your hand," directed Harris. I did, and my thumb was on the wrong side.

"Touch my hand," Harris said. I tried but missed—"by five inches," I was told. I corrected the error after a few trials but at one point I hit Dr. Harris' nose instead of his hand.

I tried writing. It was very difficult. Laboriously, I printed my initials, BF, then my first name,



Wearing distorting prisms, subject reaches out to touch Dr. Harris' hand, misses widely.



After looking through reversal prisms for 15 minutes, blindfolded subjects wrote backward.

BARBARA. I knew I was writing backwards, so I consciously wrote backwards. It was even harder, and I went back to writing forward again. Now it was easier. Like Alice, I was adapting to a mirror world.

When we looked at my printed letter, all the letters that looked forwards when I wore the mirror-reversal lenses were backwards. The letters that I consciously wrote backwards were forwards.

Dr. Harris gave me another pair of prism goggles, this time with lenses that push everything in the visual field few inches to the right. Before I put them on, I had been tested touching an arrow with my hand, which was hidden from my sight behind the lid of cardboard box. I nearly touched the arrow—the normal reaction. But, with the goggles on, I couldn't even come close, and when I took the goggles off, I was still far away from the arrow. Again, I had adapted.

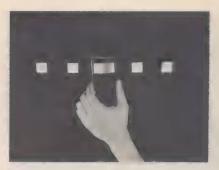
Next I tried peering through two four-inch-long prisms of glass that show straight surfaces curved and produce a fringe of color along the edges. Holding these to my eyes, I traced the edge of the cardboard box lid with my hand. The lid looked curved but—even more strangely—it felt curved. When I closed my eyes, though, the box lid felt straight again.

My reactions, according to Dr. Harris, were typical. He's a psychologist, and he's conjuring up prism-produced illusions to find out more about how and why people react to erroneous impressions of the outside world. What he learns will help reveal how normal perception works. Illusions, psychologists now think, are just one aspect of perception. If you present it with adequate sensory data, the brain perceives correctly; present inadequate or confusing data and the brain can't make up its mind. The result is an illusion.

Scientists have been studying illusions for over a century, but they're still not sure why even the simplest optical distortion affects us the way it does. Until recently, it was widely believed that the hand was quicker than the eye in detecting visual illusions. According to this theory, the eye, which is prone to error, is educated by the sense



Hand that subject doesn't use to point at target fails to adapt to distorting prisms.



When cylindrical lens makes square look wider, subject finds that it feels wider, too.

of touch, which grasps the true realities of the situation. Dr. Harris' studies indicate that the exact opposite may be true: The eye educates the sense of touch, which is more prone to error than the eye. When I looked through the prisms which make straight surfaces appear curved, the surface felt curved. If I had kept the goggles on longer, then removed them and tried to draw a straight line with my eyes closed, I would have drawn a line that curved in the opposite direction from the curve I thought I was tracing. But it would have felt as if I were drawing a straight line.

Why? "People cope with the distortion not by correcting their visual perception," Dr. Harris explains, "but by falsifying their nonvisual sense of position and movement of the arm. People trust what they see more than what they feel. This is not at all a deliberate decision to rely first on one sense and later the other. Rather, it seems that the brain automatically uses visual information, whether true or false, to calibrate the position sense."

Experiments with mirror reversal prisms provide even more dramatic

support of the theory. When I wore the mirror reversal prisms, I felt as if I were writing frontwards with difficulty when I was really writing backwards, but it was almost impossible to really write frontwards. Backwards writing felt more natural when I was looking through the prism. In a similar experiment, Dr. Harris and his wife, Judith, had subiects sit and doodle for 15 minutes a day for four days while watching their hand through a mirror reversal prism. Then the prism was covered so the subjects couldn't see anything. and they were asked to write numbers and letters as they were called out. The numbers and letters they formed were often backwards or partly backwards, but they thought they were writing them frontwards.

"One of our subjects, a girl, said, 'Oh, dear, I made a mistake,' after she formed a frontwards letter," Dr. Harris recalls. The adaptation disappears in a brief time; by the time the subjects have written their tenth letter or number, they seldom form a backwards shape.

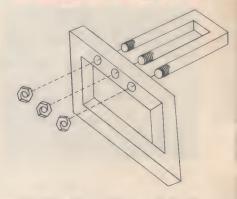
Dr. Irvin Rock, Rutgers University psychologist, has had similar (Continued on page 51)

Here are a few eye- and brain-teasers for you to try.

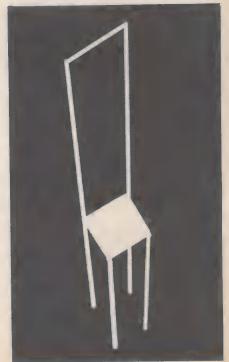


A 3-D illusion can be obtained from this pair of pictures. Place open magazine on a table; rotate counterclockwise so the words "Science Digest" are right side up. With eyes centered six inches above page, place pocket mirror (mirror-side-out) along right side of nose. Align reflection of right hand picture with your natural view of the one on the left. The result is a simple stereoptic view.





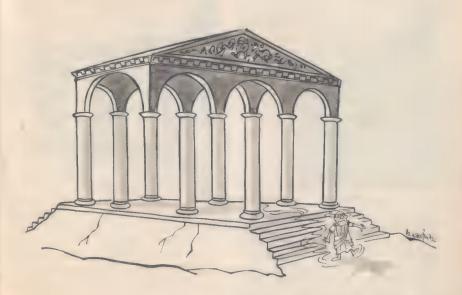
Our minds usually reject images like the one above. The fork, bracket and nuts seem impossible to us. Below, the diagonal white lines and square below will close up and become an ordinary chair if viewed through a hole one inch from the edge of a blotter placed directly above black dot.



PARIS IN THE THE SPRING

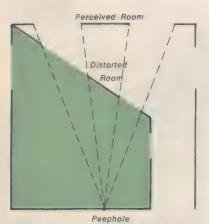
Sometimes we skip over obvious mistakes because our eyes are accustomed to certain word groupings. There's an extra "the" above. At right, illusion clockwise of motion occurs if you rotate the drawing of the seven wheels.

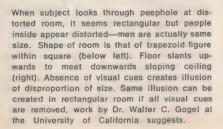


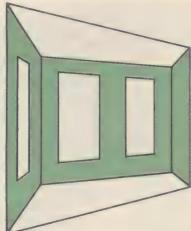


What's wrong with this picture?









results in his own experiments with prisms. He had subjects grasp a one-inch square of white plastic while viewing it through a reducing lens that diminished its size. The subjects were unable to see their hands so they couldn't figure out that they were looking through a reducing lens. Asked to match the size of the square they invariably picked a square that agreed closely with the illusory visual appearance of the square they saw through the prism. In another test, they viewed an object that looked like a rectangle and touched a square at the same time. "Most of the subjects said the square actually felt the way it looked," commented Dr. Rock. "If they closed their eyes while grasping the object they often thought they felt it changing shape from rectangle to square."

One factor is apparently necessary for this adaptation to prism vision: active movement. Dr. Richard Held of Massachusetts Institute of Technology had one subject's arm strapped to a board and moved back and forth for him while he passively watched the movement through a prism. Even after a half-hour of this, there was no adaptation in the arm. Much the same lack of adaptation occurred when Held had prismwearing subjects wheeled around in a chair or on a cart. In a kitten carousel he devised, an active kitten moved a passive one in a basket, with some interesting results. The active kitten showed normal cat reactions while the passive puss had few such reactions; it acquired them quickly, though, when it was allowed to move around.

Rock's and Harris' human subjects, as well as Dr. Held's, wear

distorting prisms for, at the most, a day at a time and sometimes it's hard to find someone who'll put up with the inconvenience for even that long. Prisms tend to make the wearer dizzy at first. In Austria, however, there's a psychologist named Ivo Kohler at the University of Innsbruck who has persuaded some of his graduate students to don prism goggles and keep them on for weeks or even months. After their initial dizziness has worn off, some of his students learned to ski and ride bicycles while wearing lenses that turned the world upside down or reversed it. Eventually, Kohler claims, these long-term prism wearers come to see the topsy-turvy world as almost normal. When they take them off, they experience a strong reverse effect. Objects are distorted but in the opposite direction of the way they were while the subject was wearing goggles. It takes days for the aftereffects to vanish.

Bizarre goggles

The most bizarre effect Kohler has achieved with his prisms was obtained with a pair of goggles in which prisms were mounted with their bases pointed in the opposite directions. Lenses like these are usually worn by persons who squint because they can't focus both eyes on the same object. The normal person who puts them on has to squint to be able to focus his eyes. Peering through the thick lenses, he soon finds he's seeing novel stereoscopic effects that involve not only geometrical figures, but colors. One student reported that colors of objects seemed to follow or precede the locations of the objects. "Most



Cube and irregular polyhedron above are obviously different shapes, but if viewed from a certain angle they look as they do below.



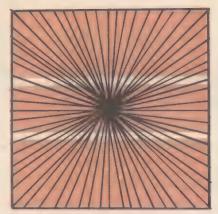
peculiar," he noted, "was a woman wearing a red blouse. She had no upper body and the red blouse seemed to be following her about a pace behind, moving its empty sleeves in rhythm with the movement of her arms." The effect, Kohler explains, is due to the fact that each prism deflects colors differently according to wavelength—

but in opposite directions since the bases are in opposition. Blue, for example, would be deflected outwards more than other colors and the eyes would have to converge more to bring it into focus. So blue seems closer than red; other hues lie somewhere in between.

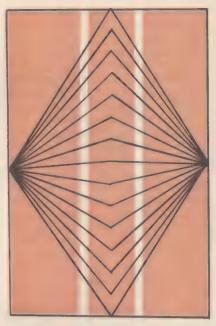
Glasses like these might help colorblind persons to discern colors by placing some nearer to them than others, Kohler thinks. Curiously, no subject who wore the squint glasses was able to adapt to the effects they produced, although one intrepid student wore them for 52 days.

Prisms aren't the only tool psychologists are using to investigate illusions. For years, optical physicists and psychologists have been setting up laboratories for mental hocuspocus in universities around the world. In some of them, you can trick yourself into seeing a 10-foot giant shrink to a two-foot midget right before your eyes. There are hideously distorted rooms that look absolutely square. A side-by-side pair of stationary balloons may appear to move swiftly back and forth. In absolutely square rooms, you may suddenly see the floor slope away at a terrifying angle; marbles roll uphill; solid ceilings appear to descend on your head; wild arrays of matchsticks form themselves into furniture when viewed from a proper angle.

The most dramatic device dreamed up in recent years to test visual distortion is still Adelbert Ames' distorted room which Ames, now dead, invented some 20 years ago at Dartmouth Eye Institute. Research with the room is still going on. The peculiarity of the Ames room is that persons or objects in one corner of an apparently rectangular room look



Optical illusions often occur because of an object's relationship to its background. The white lines above appear to be farther apart in the middle than at the ends. White lines at right appear to be closer together in the middle and farther apart at the ends. Actually both pairs of white lines are parallel. They appear bowed because of black lines that cross at many different angles. Our eyes interpreted incorrectly because of unfamiliar background.



much bigger than persons or objects of the same size in another corner (see cover). Actually, the room isn't rectangular at all (see accompanying diagram on page 50). The far wall shoots back at an acute angle and the ceiling and floor slope steeply away from each other-distortions which aren't visible when viewed from the side. A big distorted room is now used at the Graduate Center of the City University of New York, where Professor William Ittelson, a former colleague of Ames, heads the environmental psychology section. The chamber is about the size of a normal bedroom, with painted windows on its walls, a real door and a small opening in one wall through which you look to get the strongest illusory effect. I knew what to expect when I looked through the

opening but I was still startled by the illusion. A girl in one corner looked like a giant while a girl the same height in a corner about 10 feet away had shrunk to the dimensions of a midget. When the two changed places, the "giant" shrank and the "midget" suddenly rose to the ceiling.

When I walked into the room, the distortions that produced the effect were plainly visible. The floor sloped so steeply upwards towards one wall that it was like walking on a pitched roof. In the high corner, my head brushed the ceiling but in the low one, the ceiling was well over my head. One corner of the room—the one where people look small—is narrow angle, much farther back than its neighboring corner. I saw all these distortions plainly, but even when I stood right in the room, the

people in the corners still looked as if they were vastly different in height.

The reason for the illusion, Dr. Ittelson reveals, is a conflict of cues. In the distorted room, apparent rectangularity conflicts with apparent disproportion of size and, for almost everyone, apparent disproportion of size wins out. The brain has apparently decided that it's easier to believe that people grow or shrink as they cross a room than it is to believe that a room is wrongly constructed-even if you know it's wrongly constructed! The only factor that does affect perception in the distorted room, Ames and Ittleson found, is how the observer feels about the person he's observing in the room. If the person is an important figure, people tend to see him as larger than they otherwise would. A familiar figure tends to loom larger in the far corner, too. One woman, for example, saw her husband as nearer his actual size than she did a stranger.

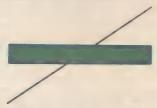
Another unique effect can be achieved in the room by running a narrow trough from one side to the other—following the general pitch of the floor but not as steeply. Looking through the viewing window, you can watch someone put marbles in what appears to be the low side, and see them roll uphill to the high side. It's an eerie effect, but your eyes are

fooling you.

Other factors also affect how we perceive illusions, psychologists have shown. A group at Pennsylvania State University recently discovered that susceptibility to some of the best-known visual illusions changes with age. The younger the subject, the less susceptible he is to the Ponzo illusion (two equal vertical lines between two converging vertical lines).



Conversely, the older the subject the less susceptible he is to the Poggendorf illusion (a continuous diagonal that appears to be discontinuous when it crosses a wide colored horizontal bar). Dr. Robert H. Pol-



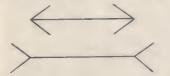
lack of Chicago's Institute for Juvenile Research hypothesizes that there are two kinds of illusory phenomena. One is characterized by large effects that work best when seen at a single glance: the other involves successive glances and comparison. The first kind of illusion decreases with age, the second, which may be a rudimentary kind of intellectual behavior, increases. Pollack thinks the visual system is probably at its best shortly after birth but declines afterwards. At some point, intellectual functioning begins to play bigger role in perception.

Social background as well as age affects illusions. When a group of psychologists and anthropologists showed two types of optical illusions to people from all over the world. Westerners were more susceptible to one kind of illusion, non-Westerners to another, a difference that may stem from the way they live. In the

West, a "carpentered" world, people are used to seeing corners from all sorts of angles and they always come out square. They have trouble with illusions involving oblique angles. In the other areas of the world, people are familiar with open plains and farreaching fields and they make mistakes with right angle forms.

There's evidence that you tend to see some illusions the way you think of yourself. A few years ago, a psychologist showed drawings of black box and a white box the same size to 50 black and 50 white boys. The whites nearly always said the white box was bigger but the blacks more often stated correctly that the boxes were the same size. Adult blacks who were pro-integration tended to be more susceptible to the illusion than non-integrationists, while African blacks apparently "fight" the illusion better than American blacks or whites: that is, they see the black and white boxes more nearly as they really are. If the same tests were carried out today among black power advocates, the white box might seem smaller than the black box.

Nearly everyone, however, sees some kinds of illusions. A man born blind who attained his sight in middle a ge was extraordinarily resistent to illusions, but he was affected by the Mueller-Lyer arrows. Zulus who live in round huts and plow



their fields in curves are susceptible to the same illusion, although they resist others. Even animals see illusions. Trained pigeons and fish select the apparently longer of two lines in an illusion, just as people do. What the lower animals, at least, can't seem to do is adapt to illusions. Chickens fitted with right-left reversing prisms, and prisms that shifted their visual field to one side, persisted in trying to pick up grain off to one side of where it really was even after months of training. A monkey fitted with reversing prisms refused to move at all for several days, then took a bound backwards —an adaptation of a sort, since these prisms tend to reverse depth perception.

Confusing?—Not really

What does it all add up to? Not as much confusion as you might think. Most psychologists studying the weird phenomena like to hope that they are on the trail of a more complete understanding of human behavior, which may help to solve some of the conflicts that make many people miserable.

"So far," says one of them, "we've spent a lot of time trying to figure out why abnormal people are abnormal. Now we're trying to discover some of the things that make normal people normal—in short, why we act like human beings."

For further reading

EYE AND BRAIN. R. L. Gregory. World University Library. McGraw-Hill. 1966.

"The Nature of Perceptual Adaptation." Irvin Rock and Charles Harris. Scientific American. May 1967.

Perception. Julian E. Hochberg. Prentice-Hall. 1964.

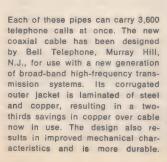
NEW FOR INDUSTRY





This rakishly-styled vehicle is not a fugitive from a drag strip; it's really a fire truck—the fastest one in the world. Called Magnum X-2, the machine can accelerate from 0 to 60 mph in 11 seconds and maintains speeds of more than 100. Its developers, Ansul Co., Marinette, Wis., refer to it as a "motorized fire extinguisher," because the tanks containing its extinguishing agents are incorporated as an integral part of the frame. The big hope is that it will be used for freeway, airport and refinery fire protection where speed is important.

Locating I e a k s in underground pipelines has been simplified with the invention of an ultrasonic detector. The technician above is testing for leakage in a Jet fuel line buried four feet deep. First a steel rod is driven into the earth to make contact with the pipeline. Then the contact probe is touched to the steel rod, and the technician listens for the tell-tale sound of escaping fuel. Delcon Division, Hewlett-Packard, Mt. View, Calif.





This giant chunk of fused quartz will wind up as mirrors, windows, lenses, domes, plates, solar cell covers and dozens of other things. General Electric, Richmond Heights, Ohio, made the ingot, appearing here in semi-finished form prior to being ground and polished. The fused quartz, called Type 125, is available in single piece solids up to 38 inches in diameter and II inches thick. This high-quality, economical quartz is especially useful because of the absence of any large bubbles.





Mount a TV right on your head (above) and forget about other distractions. That's what Diversitron of Fullerton, Calif., has designed "Miniscope" to do. Its screen area is approximately 0.9 inches in diameter and produces a standard TV format % by % inches. The display tube module on the side of the motorcyclestyle helmet contains the cathode ray tube. It connects through I light-weight cable ten feet long to the control unit which contains all regulated power supply voltages and all other controls.

A tank full of blue-gills (right) in polluted water is the subject of intense study at the E. F. Houghton Co., Philadelphia, Pa. The Company is trying to find out the types and amounts of fluids that affect living aquatic creatures. To test a particular chemical or oil product, Houghton uses five test tanks, each holding 20 gallons of water known to be non-toxic. Healthy fish are placed in the tank and then subjected to various pollutants. Test criterion is simply matter of fish dying-how many, how soon -after chemical is added.



Fat folks' hidden secrets

by Arthur J. Snider

The super-fat fellow isn't as serene as he sometimes pretends. Underneath the layers of corpulence often lies emotional turmoil. Eating helps to allay it.

While the veil has long been suspected, a Chicago physician has demonstrated it clinically. He has



shown how food serves as a tranquilizer to mask the frustrations, conflicts and tensions that beset so many who are excessively heavy.

Dr. David W. Śwanson of Loyola University's Stritch School of Medicine, recorded the psychological reactions of a group of men who were peeling off layers of fat by undergoing therapeutic starvation.

As they were shedding weight

that ran up to 473 pounds, their underlying emotional discomfort surfaced.

"This does not mean that in order to treat obesity you need to strip down and see what underlies the condition," he explained.

"We are merely saying that we have observed it among those we have studied. It is not a specific type of disorder, and it varies from individual to individual. It is not a paranoia or a severe neurosis. It is something distinctly unpleasant which they feel unable to cope with. So they eat much like the alcoholic who drinks."

Twenty-five super-obese patients, most of them weighing over 300 pounds, were studied in the hospital metabolic ward.

They ate no caloric food for up to 85 days. They received only vitamins, fluids and electrolytes. Weight loss ranged from 124 pounds in a 38-year-old man who weighed in at 370 and fasted 42 days, to eight pounds in a 326-pound man, age 32, who could take it only eight days.

Dr. Swanson was able to obtain unusual insight into the genesis of obesity.

All the patients began working at it early in life. More than half were grossly overweight before age 15. Brothers and sisters or the mother were frequently 400-pounders.

Food was the focus of their lives. They not only liked eating it but also working with it. Nine men were cooks by vocations and five others prepared the meals in their homes. Some admitted consuming meal of 6,000 to 10,000 calories.

Most had a fondness for a specific food and could not stop eating it, once having started. For one it was pork chops; for others, cheese or stew or hamburgers or chocolate chip cookies or cake.

Late eating was common. One patient admitted getting up three times night to visit the kitchen. A taxi driver carried sandwiches constantly. All said food gave them relief from complaining customers, nagging wives or bosses.

As fat folks, they were pleasant, relaxed, phlegmatic. Food produced a lethargy and drowsiness known medically as Pickwickian syndrome, from the description of the fat boy in Dickens' Pickwick Papers.

But when they had no food to suppress their unpleasant feelings, the stressed state became apparent. In many, the critical point came after fasting exceeded 21 days. They brooded, became suspicious, belligerent and depressed.

Dr. Swanson sees little hope of starvation as a permanent treatment for obesity. Preliminary findings in an evaluation now going on show that nearly all patients have returned to severe food addiction.

Portable heart hospital

Deaths following heart attacksalready cut 50 percent by placing patients in a hospital coronary care unit (CCU)—can be halved again by bringing the coronary care unit to the patient, in the belief of Dr. William J. Grace of St. Vincent's Hospital. New York.

Dr. Grace has inaugurated the nation's first mobile coronary care unit. It is an ambulance fitted with a battery-operated portable electrocardiograph, respirator, an intravenous fluid unit and other special equipment.

When an emergency call on a cardiac case comes through, the mobile unit rushes to the scene with two doctors and two nurses. Treatment is begun on the spot. On the return trip the ambulance travels at normal traffic speed since the patient is under the same type of surveillance as in a hospital coronary care unit.

Dr. Grace says the mobile unit has not been in operation long enough to determine statistically how many lives are being saved by reducing the time interval between the attack and complete medical attention. But he cites individual cases in which the patient would have died during a ride to the hospital in a conventional ambulance or auto.

Before hospital coronary care units began operation about five years ago, 35 percent of the patients admitted six to ten hours after a heart attack failed to survive. With the introduction of the CCU, the death rate has been cut to 18 percent. Dr. Grace believes it can be cut further to about 9 percent.

Trauma for nurses

The frightened patient has had surgical incision into the windpipe to facilitate breathing. Unable to talk he tries to communicate through eye movement or through feeble motions of the arms and legs. The message doesn't come through. Attempts at writing produce only a wobbly, illegible line.

How urgent is the patient's request? Does he have an adequate airway? Is he about to vomit?

"The sense of inadequacy which the nurse experiences at these times parallels the hopelessness felt by the patient," two nurses warn in the Journal of the American Medical Association.

Ruth Vreeland and Geraldine L. Ellis describe the stress that besets the forgotten nurse who works in an intensive care unit where seriously ill



or anesthetized patients are taken after surgery and where one crisis may follow another.

"These crises may include an episode of hemorrhage due to sloughing of tissue at the operation sites, respiratory infection or a psychotic reaction to the impact of the surgical procedure," the nurses say.

One doesn't have time to consult a textbook on how to meet the emergency. Insecurity in her knowledge or skill is a major stress.

Sometimes she must make a decision that would normally fall to a physician. Cardiac arrest requires an

immediate attempt at resuscitation. The few moments before the physician's arrival may enable her to save a life or prevent irreversible brain damage.

Thus the need to make a distinction between an immediate-action emergency and wait-till-the-doctor-comes emergency is another stress.

Still another stress is maintaining an appropriate balance between emanating warmth and feeling for the patient and still being objective or firm. The patient may plead not to be turned or not be required to cough or be subjected to suction because of pain. Yet to omit these measures could lead to postoperative complication.

It is usually the nurse who must offer understanding when the patient first reaches for the breast that was removed or a limb that isn't there.

Protecting the patient from the emotional trauma associated with emergencies in other patients in the unit is stressful.

"The death of the patient in the adjacent bed cannot be hidden," the nurses point out. "The increased staff concentration at the bedside, the urgent tones at the telephone, the arrival of additional mysterious-looking equipment only serve to intensify fears."

Eight hours of such tension is all a nurse is supposed to undergo a day, yet because specialized nursing talent is scarce, relief often is not available in emergencies or during a staff illness.

Vaccine against tooth decay

The first step in what is hoped will lead to a vaccine against dental decay has been taken with the successful inoculation of animals at Northwestern University, Dr. Arthur N. Bahn, associate professor of microbiology, says animals given the immunization procedure were 60 percent more protected than control animals (See Science Digest, June 1969, page 22).

The protection was conferred by blocking production of an enzyme that helps form a sticky coating on the teeth and thereby facilitates decay by giving bacteria a soil in

which to multiply.

"We are excited about the prospects," says Dr. Bahn, "but much work must yet be done. We have to repeat the experiment. We have to purify the enzyme and we have to determine that the antibodies produced by the animals will inhibit the enzyme in a test tube."

Efforts to immunize animals have been made before but only against a single type of decay-producing bacteria. Dr. Bahn hopes his approach will be universally effective against

all decay-producers.

Who is the doctor's "doc?"

When a doctor needs a doctor, whom does he pick? Usually not the best physician he knows, contrary to what one might expect.

A study using questionnaires and personal interviews sampled 468 physicians in one state and found that doctors tend to choose their equals rather than superior physician.

The unconscious fear seems to be that if the chosen physician were superior, he would tend to treat the doctor as a patient, not as a colleague. That would be too much of a price to pay in terms of lost rank and subordination for most doctors.

Dr. Herbert Bynder of the University of Colorado, who conducted the study, defines "equals" as close friends or doctors who refer patients to each other.

In 80 percent of cases, the physi-



cians knew the man he had chosen, and in almost half the cases, the relationship was close.

In medical school a student is taught that a physician must be emotionally detached in his attitudes toward patients. Dr. Bynder questions whether this value can operate when the doctor and patient are socially equal.

The figures change somewhat when a doctor has a serious illness. In that case, 55 percent of the chosen physicians were of high quality. But the tabulation showed that as the seriousness of a condition decreased, so did the quality of the physician chosen.

How to stop smoking

If you're considering giving up smoking, don't approach the project in terms of self-denial.

"The ex-smoker should not believe he is giving up an object of value, however dependent he may be on it," suggests Dr. Harold S. Diehl in a book, *Tobacco and Your Health*.

"If he begins to feel sorry for himself and broods on his sufferings, they may become more severe and indeed unendurable. He must recognize that he is teaching himself more positive, more constructive, more rewarding behavior.

Dr. Diehl, who has retired as senior vice-president for research and medical affairs, American Cancer Society, offers these further pointers:

• Set a date for "Q-Day" when you are to stop completely. As it approaches, gradually reduce the number of cigarettes smoked week by week, day by day. There are various ways of reducing. One is to decide to smoke only once an hour or to stop smoking during certain hours. Or half the number of cigarettes smoked week by week. Or smoke only half the cigarette.

 Make it a real effort to get a cigarette. Wrap the package in several sheets of paper or place it in a tightly-covered box.

• Keep a daily record, on a card, of cigarette consumption, of when

the desire was most or least intense. In your gradual withdrawal you may decide to eliminate those daily cigarettes you find were wanted very little. A smoking log will give you information about yourself, make you more aware of what your smoking habits are.

• Write down the reasons you smoke and, in another column why you should give up cigarettes. Thoughtful concentration on reasons for quitting is important in changing behavior. (For information on a smokers' self-testing kit to help one understand personal reasons for smoking, write to the National Clearinghouse for Smoking and Health, United States Public Health Service, 4040 N. Fairfax Drive, Arlington, Va., 22203).

A week before Q-day, concentrate on reasons you should not smoke risk of disease, blunting taste of food, cost, coughing, bad breath, smell of morning-after ash trays.

On Q-day, keep as busy as you can. A vacation period of camping, mountain climbing or tennis is good time to stop.

Drink frequent glasses of water, nibble fruit or cookies and partake of self-pleasing food.

For a few days, spend as much time as possible in libraries or other places where smoking is forbidden. Try a spate of motion pictures.

For at least two weeks keep away from friends who are heavy smokers.

If you have had a specific pattern that you've followed after dinner, you may want to change it. Skip familiar television programs. Sit in different chair. Try crossword puzzles or take on the household tasks you've been putting off.

Eye in the sky for a hungry world

Agriculture has caught up with the Space Age. It's using sky-high computerized sensing devices to keep a close eye on crops and livestock.

by Robert B. MacDonald

SPACE-AGE aerial-scanning techniques devised to give man a better look at Venus and Mars are being put to work in agriculture. Unique sensors are detecting Canadian thistle in soybeans, alfalfa weevil infestation, drought conditions and diseased areas in crops. This spin-off from the nation's space programs already is proving its value in dollars and cents on the farm.

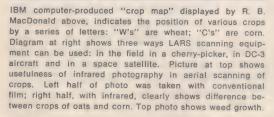
At Purdue University's Laboratory for Agricultural Remote Sensing (LARS) in Lafayette, Ind., scientists are coordinating the efforts of several research organizations to develop a new approach to "photographing" farm fields and livestock. LARS uses a battery of sensing devices that can "see" things invisible to the naked eye. The composite "picture" is recorded in electronic form on magnetic tape instead of on film. This broad information is then analyzed by Purdue's IBM System/360, Model 44 computer. In minutes, the computer detects things that would require days to discover by photoanalysis-plus many that would completely escape the standard photo techniques currently used for this.

Speed and accuracy of the new computerized sensing technique will enable farmers, agri-business concerns, farm cooperatives and federal planning agencies to gear more precise crop forecasts to market demands.

Miscalculations of agricultural conditions both here and abroad have caused phenomenal losses to American farmers. In 1966, cattle estimates were low by more than a million head and down went beef prices. Wheat exceeded estimates and down went wheat prices. Cost to agriculturists: Several hundred million dollars. In 1967 the crop production program called for sharp increases in certain commodities on the basis of predictions of world shortages and increased hunger. Late in the season, world production was discovered to be much larger than estimated. The big increase in foreign demand for American food

Robert B. MacDonald is Technical Director of the Laboratory for Remote Sensing at Purdue University.







failed to develop. Result: A sharp decline in farm prices at home and abroad that depressed farm incomes some 10 percent from the 1966 depressed level!

LARS' experiments at Purdue are proving to researchers how such costly mistakes can be avoided. Today, their unique sensors are going higher and seeing farther. LARS first mounted them in a laboratory, then on a truck, then in the bucket of "cherry picker" at the end of a folding boom. More recently sensors have been flown in aircraft, and the Apollo 9 space craft, launched in March of this year, successfully carried one into space for the first time.

Right now LARS' sensors mounted in low-flying aircraft are accurate enough to permit a plane flying over the Corn Belt after tasseling to evaluate the upcoming crop, pin-pointing data on retarded pollination and weed infestation within areas as small as 100 square feet.

FIELD

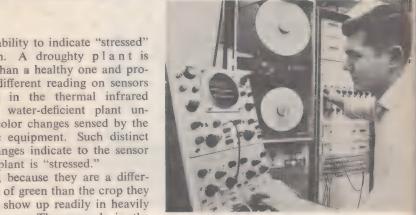
With such information, the farmer would not have an unpleasant surprise at the end of the growing season. If a LARS aircraft flies over Indiana and records the total acreage of short, green vegetation, it will have produced a winter wheat census. The farmer will know how his wheat acreage compares with the surrounding marketing area.

LARS aerial sensing also has the



Some LARS crop-scanning can be accomplished right in the field by a special mobile van such as the one at left. Spot checks such as these enable farmers to more accurately predict the outcome of harvest and profits.

Tapes from sensing equipment in the field and in the air are converted into computerreadable form and fed into an IBM System/ 360 Model 44 computer. The analysis results in "crop map" on opposite page.



unusual ability to indicate "stressed" vegetation. A droughty plant is warmer than healthy one and produces a different reading on sensors operating in the thermal infrared band. A water-deficient plant undergoes color changes sensed by the electronic equipment. Such distinct color changes indicate to the sensor that the plant is "stressed."

Weeds, because they are a different shade of green than the crop they supplant, show up readily in heavily infested areas. Those weeds in the soybeans, mentioned earlier, were detected when the beans were only 12 inches tall-from altitudes above 2.000 feet. Weed infestations cause an estimated loss of \$3.8 billion annually to the American farmer. If remote sensing can reduce these losses just 10 percent, the economic benefit would be \$300 million per year.

Plant fertility already can be spotted from the air through evaluation of apparent plant health and degree of growth and cover. Eventually, soil fertility, determined from observing the plants, may be analyzed from air.

The LARS program promises much in irrigation analysis, too. Present sensors can indicate how well ditch irrigation is functioning, based on the apparent temperature of the plants as recorded on the infrared band (the droughty plant is hotter). Additional use of infrared sensing and long-wave sensors may permit reading of actual soil moisture, based on temperature, humidity and soil type. This, in turn, will permit more effective application of fertilizer, when the moisture situation is most profitable.

For livestock management, overgrazed and under-grazed areas can now be detected by LARS from the air, permitting the cattleman to shift his stock accordingly. If over-grazing is a chronic problem he may need to cull out the worst cattle. If the sensors tell him his land is under-grazed, possibly he can handle additional

head. If the capacity of grazing lands can be boosted 10 percent by remote sensing information for the rancher, the result will be an annual increase of 3.5 million more calves, depending on feeder cattle prices—a matter of some \$350 million annually to cattlemen.

A sick animal, like a sick person, has an elevated temperature. Under study now is feed lot surveying to permit infrared detection of ailing stock.

LARS' first efforts at aerial sensing could differentiate only between green vegetation, water and bare soil. Now, certain programs can identify specific crops by their unique "signatures" on the tape. These include corn, soybeans, wheat, oats, rye and alfalfa.

Of some 18 wavelength "bands" of radiance now read by the sensors, only three to seven "bands" are generally used to identify a specific crop species. Present sensors measure minute degrees of heat and color. Utilization of additional selected wavelength bands should raise the percentage of accuracy. Even present systems can tell a plowed field from an unplowed one, or even from a barrowed field.

A field that appears to the naked eye to be maturing corn may be analyzed to determine the degree of maturation by using infrared sensing. Infrared photographs of corn fields clearly show distinction between two varieties of hybrid corn. To the eye, both appeared the same. Analyzed by infrared techniques, however, the field was clearly divided between one variety and another because one had matured faster and had a greater "reflective capacity" in a particular infrared band. The

LARS sensors see the same thing, but log it in computer language on tape for instant computer analysis.

The high speed printer of the IBM 360 actually produces a "crop map" (somewhat like an aerial photograph) of a sector, perhaps one mile wide by several miles long. Each crop is denoted on the printout by its initial letter: a field of wheat is a series of "W's"; corn is a block of "C's." The computer has been instructed to leave weedy areas blank, clearly showing the effect of conditions such as weed infestations on the profit potential. Other blank strips indicate roads or waterways.

LARS will continue experiments with truck-mounted sensors, plus a DC-3 owned by the University of Michigan for additional studies from aircraft. Future space capsules will be designed to carry multi-channel photographic equipment and sensing gear for making "spectral" measurements.

The information gathered will serve as springboard for larger surveys until the world's agriculture (literally) has been overflown by remote sensors, probably aboard "ERTS" (Earth Resource Technology Satellite) to be launched in the early 1970s.

Today, agriculture is interrelated world-wide, not only with other agriculture, but with other facets of our culture. That's why the LARS project is supported by the National Aeronautics and Space Administration and the U.S. Department of Agriculture—to develop techniques for collecting information on a world-wide basis to develop and manage the earth's resources. A hungry world will not long be content to live in peace beside a well-fed America.



Flying underground

oooooosh! The missile takes off but instead of going up, up, up and away, it heads downwards, right into the earth. A mistake? Not at all. This steel and plastic projectile developed by Sandia Corporation of New Mexico is made to fly underground. Used to quickly identify materials beneath the surface of the earth, usually in remote areas, it can penetrate to a depth of 200 feet. About 10 feet long, it weighs over 1,000 pounds.

The missile is dropped from planes or helicopters like a bomb or fired from mortars. Depending on how it's launched, its speed varies from 41 to 1,870 miles an hour. As it heads downward, it unfurls a long antenna which remains above ground to radio messages back to an operator. Changes in speed as the probe churns through the earth are sensed by an accelerator and indicate what kind of material it is passing through. It travels faster through clay, for example, than it does through coarse sand.

So far, reports Sandia, the low-flying missile has been able to identify several different kinds of sand, silt, clay, water, mud and a few kinds of bedrock.

Supermale fish from sex hormones

IN A PRIMITIVE FISH called the killifish, a supermale with two male Y chromosomes instead of one X and one Y almost always gets the female. YY killifish boss XY killifish around, too, all of which may prove that some males are born more aggressive than others because of their genetic make-up (in case you wondered).

The killifish study is under way at the State University of New York's Downstate Medical Center, where Dr. James B. Hamilton, head of the department of anatomy, is breeding abnormal killifish with doses of sex hormones. In a species as low on the evolutionary ladder as the killifish, carefully-timed administration of sex hormones can produce YY males and other abnormalities.

To test the supermales' aggressiveness, Dr. Hamilton had them compete with normal XY males for the opportunity of mating with normal



Genetically abnormal killifish are being bred by Dr. James Hamilton for research to lead, hopefully, to data on human abnormalities.

females. In a situation like this, male killifish dart toward each other threateningly, occasionally taking a nip with their sharp teeth. The male who wins out circles the female, grasps her with his fins to make her lay eggs and then fertilizes the eggs. Each of the 14 pairs of YY and XY killifish at Downstate competed once a morning four to seven times a week until each pair had competed 20 times or one male fish was dead.

The supermales had a distinct superiority in this competition, Dr. Hamilton says. "Spawning was induced by YY males in 137 tests, by XY males in 18 tests," he reports. "Greater success of the YY than of the XY genotype characterized all 14 pairs of males, although the degree of superiority was less in some pairs than in others."

This means that the YY males were successful 88 percent of the time, the XY males only 12 percent.

As the study progressed, many normal XY males began to avoid YY males. Sometimes the avoidance became so marked that the normal male would remain at one end of the tank near the bottom. The YY males dominated the XY males more quickly when both kinds of males lived together than when each was housed singly.

Dr. Hamilton indicates there are problems in applying data on killifish

chromosomal abnormalities to human chromosome abnormalities (see Science Digest, January 1969 and June 1968). "In humans this issue is complicated by the presence of more than the normal number of chromosomes in the XYY men. Whenever there is an extra or missing chromosome, there is a tendency to mental abberation." Disentangling the two influences will be a long and difficult process, he believes.

Toothy retardation

Mentally retarded children have a much higher percentage of poorly formed teeth than normal children. University of Pittsburgh study shows. Mongoloid children had the most abnormalities, 74 percent. among the retarded group, compared to 46 percent for brain-damaged children. Only | percent of the normal children had such abnormalities. The canine teeth were most often affected in mongoloids; the first molar in the brain-damaged. "The nature of each abnormal structure of the individual dental crown suggests the precise developmental stage when such an abnormality must have been initiated," say the Pittsburgh investigators.

How to grow shorter girls

A six-foot woman may make a great model or showgirl but many of the nation's female six-footers dislike their unusual height. At the *University of Utah*, Dr. Marvin L. Rallison, a pediatrician, is doing something about it. He is giving a selected group of young female patients (average age 12) estrogen and progesterone to speed up their attainment

of final height. "The earlier growth stops, the shorter the person will be," he explains. Three pioneer patients are now one and one-half to two inches shorter than they would have been without treatment, he says. Dr. Rallison predicts adult height by charts and bone maturation rate.

This galaxy-like structure is actually a molecular model of a crystal lattice forming the inorganic material of bone, built in conjunction with research by Dr. Edmund Pellegrino, vice-president for health sciences at State University of New York, Stony Brook campus.





What can you do with an avalanche of garbage?

Some scientists are answering the question with, "Sell it for a profit, of course." And they just may be right.

by Kenneth A. Kovaly

T's AN UNCOMFORTABLE FACT that the U.S. is producing garbage faster than people. And by 1980, the 240 million people in this nation will be turning out more than 250 million pounds of garbage every year.

Long before that time, the problem of what to do with this mountain of garbage will have to be faced. Already such cities as New York, Washington, D.C., San Francisco and Chicago are at the crisis point.

A Chicago official gives this dire warning: "We're running in front of an avalanche, and it's already beginning to bury us."

Each one of us in the U.S. produces about four and a half pounds of garbage each day. Within 10 years

this horrifying figure may even go as high as six or eight pounds a day.

The classic ways of disposing of garbage just aren't working anymore. Cities are running out of places to dump garbage. Land fill projects have been completed. Most incinerators are so obsolete that the air pollution they cause is as bad or worse than the garbage glut.

The problem of solid waste disposal has reached such proportions that countries such as Japan have set up a five-year plan to seek solutions. S weden has organized a central agency to coordinate the handling of wastes for the entire nation. In the U.S. millions of dollars are being spent to come up with the technology needed to combat the garbage crisis. Many of the experts working on the problem seem to think that somehow we can use garbage as a raw material.

One of these schemes comes from a British firm, Lawden Manufacturing Company of Wolverhampton. Lawden has developed a process to turn garbage into fertilizer, called "Sweetsoil." Sweetsoil would be much cheaper than comparable fertilizers now on the market.

In the Lawden process, everything —paper, bottles, cans, bicycle, or even a sofa—goes in at one end. A clean, bagged fertilizer comes out at the other end.

Garbage is first tossed into a shredder where it is chewed up to pieces six to eight inches long. From the shredder, the pieces feed into a digester for a five-day stay while water and air are carefully metered in. In the digester, the natural bacteria starts to ferment the mass and the temperature goes up to 160°, killing all harmful microorganisms.

Next, metals and large inert fragments are screened out and the material passes into a grinder. The grinder reduces any glass to a harmless powder and destroys any remaining lumps.

The result of this shredding, digesting, grinding is "Orgin," which can be used as is for a soil conditioner. It will bind light sandy soils, break up heavy clays or sweeten arid or sour land. Orgin can also be used, with chemical ingredients blended in, as a fully effective fertilizer.

The idea of using garbage as a raw material has also intrigued experts on this side of the Atlantic. In Connecticut, two engineers have stretched this idea even further than their British counterparts. Alfred Eggen and Orlo A. Powell Jr., at the University of Hartford, are working on a system to dispose of solid wastes, including junked autos, and recover useful materials.

Garbage would be incinerated and the heat produced could be sold or turned into electric power. Heavy ferrous scrap would be recovered from this part of the process. At the same time scrapped autos would be chewed up in a huge shredder.

The system would actually be broken down into three separate subsystems. The first, the auto shredder, would simply shred the autos. The power production system would use gas turbine burners and could be operated by either a utility company or a company with large power needs. Power from this part of the system would be cheap.

The engineers estimate that power could be supplied for under one mill per kilowatt hour. This assumes a profit from selling the by-products of the burning operation. Even the op-

timistic estimates for the cost of nuclear power in 1990 come to more than two mills per kilowatt hour.

The key to successful operation of such a plan falls mainly on the third subsystem-where actual material will be produced from the burned garbage. For example, the ceramic material resulting from burning trash would have structural properties several times better than concrete. The scrap metals could be sold as such or combined with the ceramic to make composite building materials. Such composites could be used as structural planks, beams and wall sections. Ceramics could be used to form blocks for construction or poured in place for structures. And the rough ceramic aggregate could be used in road beds and wherever gravel is now used.

At this point, the two engineers have proved, to their own satisfaction at least, that such a system is possible. The ultimate result of putting the idea into practice: Cities, rather than paying to dispose of their garbage could conceivably sell their trash for seven dollars a ton.

With the problem of garbage disposal as severe as it is, no potential dumping ground is being overlooked. Thus it is only natural that the largest dumping ground of all—the oceans—should be considered as a way of getting rid of solid waste.

Dr. Robert A. Erb of the Franklin Institute Research Laboratories in Philadelphia has come up with an imaginative way of using the ocean. Erb says it is possible to build a pipeline to the sea to carry garbage out beyond the Continental Shelf, into deep water. Such a line could carry certain industrial wastes as well.

The pipeline would be part of a

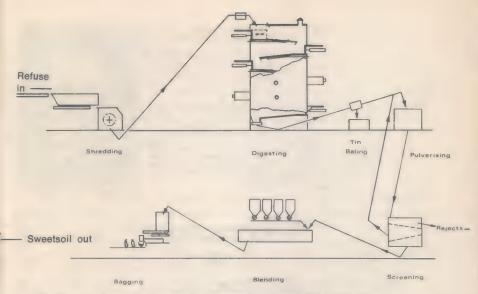
regional system for collecting wastes from the Delaware Valley area. One pipe would run from near Trenton, N.J., to Philadelphia. Another pipe would lie along the Delaware River, past Wilmington, and on up to Philadelphia. At Philadelphia, the two lines would flow into one large pipe that would run across southern New Jersey, past Atlantic City, and about 100 miles out to sea taking the waste beyond the Continental Shelf into water about 1,200 feet deep.

New barging techniques, however, are also getting the attention of the experts. At Harvard, a sanitary engineer, Melvin First, is studying the possibility of dumping burned garbage into the sea. The garbage would be put on board large incineratorbarges, burned on the way out to sea, then dumped into deep water.

First studied the engineering problems of a sea-borne incinerator and then ran a thorough analysis of the logistics of such an operation. He found that the idea did indeed have much merit. As part of the Harvard project, University of Rhode Island scientists are studying the effects of dumping burned garbage into the sea.

At a test site off the coast of Rhode Island, the scientists dive beneath the surface, in a two-man sub, to actually see what happens to the incinerated garbage after it is dumped. They have also run a series of biological tests, feeding the burned residue to marine animals. Their findings indicate that the burned material will not harm marine life. However, their work has even a greater goal.

Dr. Saul Saila, one of the scientists at Rhode Island, has been gathering data on current speed, current direc-



Among the newest schemes for getting rid of garbage and refuse is the British Lawden process—a giant mechanical garbage-eater that takes paper, bottles, cans—even bicycles—and organic material, chomps everything and turns it into bagged, sterilized fertilizer.

tion, wind velocity and other variables in the test area. With the data he hopes eventually to build computer model to simulate the effects of the sea on incinerated waste. With such a model, Saila could choose spots where the current and other natural actions would greatly disperse the incinerated material so that no pollution will occur.

The ocean does indeed look like potentially attractive dumping ground for garbage. The oceans contain some 329 billion cubic miles of water. If, for example, 40 million gallons of waste per day were emptied into the ocean for 1,000 years, the waste would be diluted with five million times its volume of sea water.

While the schemes for dealing with the growing garbage problem vary greatly, the solutions all rest on the economics of a technique. Not only must a method get rid of waste without causing other problems, but it must do it at a low cost. Thus, the ideas for turning a profit from garbage seem to get a great deal of attention. And they may soon be getting much more.

Scientists from the Bureau of Mines have found gold and silver in the piles of burned' garbage in the dumps of Washington, D.C. According to these scientists, there may be \$14 worth of gold and silver in every ton of burned garbage. The precious metals come from photographic chemicals and film, old coins, costume jewelry, silverware and solder from electronic equipment. With gold and silver in those mounds of trash, it seems to be just a matter of time before someone actually begins to make a profit from garbage.

ISAAC ASIMOV EXPLAINS

Each month Dr. Isaac Asimov chooses one of the questions you send in to answer. He does not make the job easy on himself, for in past months he has written about such things as relativity, parity and the basic nature of light. Following Dr. Asimov's answer are the answers to some of your other questions written by regular members of the Science Digest staff.



Refraction vs diffraction

When sunlight passes through a glass prism, the direction of the redlight component is least changed; when it passes through a diffraction grating, the direction of the red-light component is most changed. Why the difference?

IGHT can be viewed as a wave motion, and ordinary sunlight is a collection of waves of different lengths. Light of different wavelengths produces different effects on our retinas, and it is that which gives us our sensation of color. Of visible forms of light, red light has the longest wavelength; then orange, yellow, green, blue and, finally, with the shortest wavelength, violet.

When light passes from air into glass, water or other transparent media, it slows down. If a beam of light approaches a piece of glass at an oblique angle from the right, the right side of the beam, which strikes

the glass first, is slowed down first. For an instant, the right side is moving slowly while the left side continues at full speed and the result is that the beam changes direction as it enters the glass. This is "refraction."

The same thing would happen if a column of soldiers were to march obliquely from a paved highway into a plowed field. The soldiers on the side of the column toward the field would reach it first and be slowed down first, and unless a conscious effort were made to prevent it, the column would shift direction as it entered the field.

The slowing effect of the field is produced by the difficulty of pulling one's legs out of the soft soil. Once free, the leg moves through the air above as quickly over the field as over the highway. This means that a long-legged soldier who makes fewer contacts with the ground in a given distance, thanks to his long

stride, than a short-legged soldier does, is slowed less. A column of long-legged soldiers would have their direction of march changed less than would a column of short-legged soldiers.

The long-wave red light is similar, in this respect, to a long-legged soldier. It is slowed less than any other kind of visible light and is, therefore, refracted least. Violet light is, of course, refracted most.

Diffraction involves a completely different principle. A wave motion can freely move around an obstacle that is no larger than the length of one of its waves. The larger the obstacle, the less freely it can move around them.

The wavelengths of light are so tiny (about 1/50,000 of an inch long) that light does not bend noticeably about ordinary obstructions but continues on in a straight line past them and produces sharp shadows. (Sound waves, which are entirely different in nature from light waves, are much longer. That is why you can hear around a corner, but can't see around one-at least, not without mirrors.)

A diffraction grating consists of large number of very fine opaque lines drawn parallel to each other against a transparent background. The opaque lines are fine enough so that even the tiny light waves, passing through the transparent regions nearby can slip around them a little. This is "diffraction."

Clearly, the longer the wavelength of light, the smaller the obstruction of the opaque lines and the farther that light can reach around it. The long-wave red light can reach farthest around the opaque lines and is therefore diffracted most. Violet light is, of course, diffracted least.

Both a refracting prism and a diffraction grating will yield a "rainbow" or spectrum. One spectrum is, however, the reverse of the other. Reading outward from the original line of direction of light, the refraction spectrum is: red, orange, vellow, green, blue and violet. The diffraction spectrum is: violet, blue, green, vellow, orange, red.—Isaac Asimov



"You must find a way to vent this antagonism. I suggest you get married as soon as possible."



Why Do You Read So Slowly?

A NOTED PUBLISHER in Chicago reports there is a simple technique of rapid reading which should enable you to increase your reading speed and remember more of what you read. Most people do not realize how fast, accurate reading can bring extra pleasure and success in everything they do.

The details of this method are described in a fascinating new booklet, How to Read Faster and Retain More, sent FREE on request.

According to this publisher, most people regardless of their present reading habits and reading skill can use this method to improve their reading ability to remarkable degree. Whether reading books, stories, newspapers, or technical matter, it becomes possible to read long sentences at glance . . . entire pages in seconds.

To acquaint the readers of this journal with the easy, self-training method, test-proven in homes, schools, and corporations, the company has printed full details in a new booklet, *How to Read Faster and Retain More*, mailed FREE to all who ask for it. No obligation.

Simply send your name, address and zip code to: Reading, 835 Diversey Pkwy., Dept. 690-017, Chicago, Ill. 60614. A postcard will do.

Micro-mini photography

A THERMOMICROGRAPH, invented by staff engineers for a Connecticut company, makes highly enlarged heat pictures of microscopic objects.

The invention is a development of the infrared microscope which is already in use for such tasks as testing the heat characteristics of high-speed sewing machine needles, checking the performance of miniature ball bearings and studying the heat-seeking characteristics of night-flying moths.

The new instrument, on which J. Richard Yoder and Robert B. Mc-Intosh Jr., recently obtained Patent 3,435,212 for the Barnes Engineering Company of Stamford, Conn., is expected to find early applications in the design and testing of the pinhead-sized microcircuits that are of growing importance in electronic equipment.

Later it should be useful in examining microscopic physical, chemical and biological processes. The inspection is non-destructive; nothing touches the object.

The Barnes thermomicrograph includes a motor-driven table on which the object is moved back and forth in scanning pattern. At the same time synchronized light, which is turned bright or dim by the electrical output of the radiometric microscope, is directed at a light-sensitive surface such as Polaroid film.

The areas of highest temperature show white, and as the heat lessens they grow progressively darker.

Every object at a temperature above absolute zero emits infrared

rays, which are beyond the red end of the visible spectrum. The thermomicrograms, or heat pictures, show whether the parts of microcircuit are in order and may reveal troublesome hot spots.

Temperature differences of less than a degree can be measured in areas smaller than the cross-section of human hair.

The thermomicrograph is a wedding of the infrared microscope and the infrared camera, both of which Barnes already makes for various purposes.

-Stacy V. Jones

Prototype thermomicrograph, basically combination infrared microscope and infrared camera, is operated here by one of its patent holders, J. Richard Yoder. Holder containing microcircuit measuring .04 x .04 inches is under microscope. Yoder holds thermomicrogram.

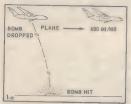


How good are you as a physicist?

by John and Molly Daugherty

E NERGY is a measure of the ability or capacity to do work. The study of energy is of major importance to the study of physics, and the understanding of energy requires the development of concepts of force and work. A force may be a push or pull. Work involves the motion of a force through distance—a measure of accomplishment. What do you know about physics?

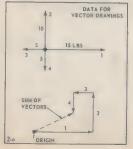
1. A bomber flying 600 miles an hour in level flight at an altitude of 6,400 feet drops a bomb and then continues on course with the same velocity. Assume there is no air friction on the heavy bomb. The plane meets air resistance but can maintain its uniform speed of 600 miles an hour. Choose the picture which shows where the plane will be when the bomb hits.

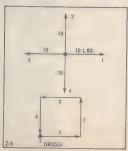


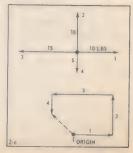




2. Scaler physical quantities have only numerical value. But forces have direction as an additional property. Such quantities are called vectors. To add two or more vector quantities acting on a given point, a graphical polygon may be drawn. Draw any one of the vectors to scale with an arrow at the end pointing the direction in which it acts. Then from that arrow draw the next vector until all of the vectors are used. The sum of the vectors or resultant is the line needed to close the polygon measured from origin (starting point) to the last arrow drawn. Choose the vector drawing made from the data above it, which has a zero resultant.

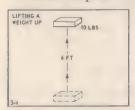






3. Work in a popular way may refer to any mental or physical effort. In physics work means force times distance: $W = f \times d$. The force (or some part of it) must be measured in the same direction as the object moves when the force acts on it.

Choose the picture in which no work is being done.



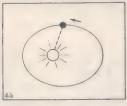


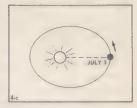


4. Energy is defined as the capacity or ability to do work. There are many kinds of energy. Mechanical energy may be potential or kinetic. Potential energy is stored-up energy caused by a body's position. For example, a raised pile-driver can do work when it is released. Kinetic energy is energy body has when it is moving. Your car in motion has kinetic energy. Potential energy may be transformed into kinetic energy. The principle of conservation of energy states that the sum of the kinetic and potential energy remains constant.

Choose the picture of the earth in orbit around the sun in which the earth has its maximum kinetic energy.

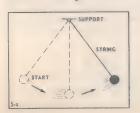






5. A simple pendulum with heavy bob suspended by a flexible string from firm support illustrates the transformation of mechanical energy. Pulling the ball to one side elevates it, and on release its potential energy sets it in motion. As it passes the center position, its kinetic energy causes it to rise on the right.

Choose the picture which shows the pendulum ball when it possesses both kinetic and potential energy.







Answers:

1 - C The bomb has the same horizontal speed the plane does at the moment of release. And all the time it is falling, the bomb has this forward motion. The force of gravity alone causes the downward motion. The direction of the velocity vector of the bomb's flight through the air before hitting continually changes as shown by the curved line.

This bomb would hit in 20 seconds and be directly under the plane at all times in flight. The bomb and the plane, too, would travel 3.36 miles horizontally. Actually, the plane would be a little ahead of the bomb because of

air friction on the bomb.

2 - b Here, after the four vectors are drawn to a convenient scale in their respective directions, the polygon is already closed—no dotted line is needed.

In 1 - a, a dotted line from the origin to vector number 4 in that direction is the sum or resultant of the vectors. The resultant represents the single force and its direction which could take the place of the four separate forces acting on the point shown in the data. The order in which you plot the vectors doesn't matter provided their directions are correct.

3 - b Here the man does *no* work while waiting for the bus. The suitcase is no longer being moved, so the distance equals zero. $W = f \times d = 20$ lbs $\times 0$ ft = 0.

In 3 - a, to lift the weight vertically requires a force of 10 pounds, $W = f \times d = 10$ lbs $\times 6$ ft = 60 ft lbs.

In 3-c, to push the piano 10 feet requires a force of 70 pounds. W = 70 lbs x 10 ft = 700 ft lbs. If the piano were lifted instead, the force required is 400 lbs.

- **4 a** On January 3 the earth is closest to the sun. On July 3 it is farthest from the sun. From July to January its distance or elevation from the sun decreases gradually. This means that the earth's potential energy of position decreased and the loss of potential energy must show up as an increase in kinetic energy. Since the mass of the earth is constant, its velocity in orbit increases. K.E. $= \frac{1}{2}$ MV².
- **5 c** The swinging pendulum had its maximum kinetic energy as it passed its midpoint in 5 b. Now this kinetic energy is being changed to potential energy as the ball is being elevated. In 5 c the ball has both kinetic and potential energy. The kinetic energy which remains is needed to reach the maximum elevation of the starting point where all of its energy will again become potential. The pendulum swings back and forth, but friction will finally bring it to rest at the center point.

Score yourself:

4-5 right
2-3 right
Not up to your full potential!
Your force lacked direction!

Phoenixes of man's past

Mysterious Places. Daniel Cohen. Dodd, Mead. (\$5.95).

Rising from the ashes of mankind's civilized—and uncivilized—past, the Phoenixes of myth, legend, oral history and pure baloney float—beckoning the imagination with all the fascination of colony of sirens.

What Daniel Cohen has done here is to—seemingly—fall for the enticing siren come-on, then go clomping through the colony tweaking noses, pinching pretty bottoms, pulling a pigtail here and there and having a whale of a jolly time—without getting booby-trapped by any pale pink fantasies.

He takes the reader down through the intriguing tales of places like Atlantis, Lemuria, Easter Island, Camelot, Stonehenge, Zimbabweand all the way to El Dorado. Everybody involved in the development of a myth, or a sound theory, gets full credit. Plato's origination of the Atlantis tale is thoroughly discussed; Donnelly's Atlantis: The Antediluvian World has its day in court and comes off clearly fable. You'll sail the Arena with the Dutch admiral Jaakob Roggeveen to an island he named "Paasch," or "Easter," and stand on the sidelines asthe great fight ensues as to whether

people from the East or the West built all those statues. And why. You'll ride Kon Tiki, and listen to Thor Hyerdahl's carefully framed arguments to prove that the statue-builders came from Peru; then, you'll listen to the "establishment" try to rip him to shreds.

Foraging through the musty records of ancient English abbeys, you learn that there probably was, indeed, an "Arthur" to support the romantic legend. But he was a far cry from the character painted in fiction. Some of the nonsense about him is nicely reported in the book. For instance, reports the author: "Despite the problems connected with establishing the existence of Arthur in the first place, Debrett's Peerage, the Who's Who of British aristocracy, has recently linked Arthur with the reigning queen, Elizabeth II."

All told, Mysterious Places is typical of this author's highly rational and reasonable approaches to highly controversial subjects, in fields that often attract a fanatical fringe. The book flows smoothly in a nice, readable style; is well documented, gives credit where credit is due and pokes some gentle fun at the dreamers and wishful thinkers who'd like to continue believing in fairies.—RFD

Other new books of interest Poisons in Your Food. Ruth Winter. Crown Publishers. (\$5.95). The next thing you eat may be contaminated

by some pesticide or some harmful bacteria that got its start as the result of poor sanitary conditions in packaging. While the author's inten-

tions were probably quite noble in alerting the public to alarming conditions that exist everywhere and which certainly should be remedied. the book leans toward scare tactics and leads one to believe that with the conditions that exist today it's a wonder we don't all have food poisoning at least once a week. It's a well-documented account of what's going on-or isn't going on in the food business-food processing, packaging, inspection, in vending machines, restaurants, additives, dietary foods. It's fascinating, but be prepared to lose your appetite temporarily.

Insomnia: The Guide for Troubled Sleepers. Gav Gaer Luce and Dr. Julius Segal. Doubleday. (\$6.95). While everyone isn't affected by insomnia, most people do experience it on occasion. Those who don't find it an incomprehensible situation. It's one of those subjects of frequent discussion. This account of the latest research on sleepless nights and its causes are extremely interesting and educational to insomniacs and those who sleep like babies. (You'll find that all babies don't sleep as well as one would expect a baby to sleep either.)

Follett Family Life Education Program: Families Live Together, The World of Living Things, How New Life Begins. by Esther K. Meeks and Elizabeth Bagwell. Living Things and Their Young, How We Are Born, Man and Woman. by Julian May. Follett Publishing. (All Books \$3.50). This series of books gives honest, straightforward answers, in pictures and words, to questions countless parents agonize

over in answering. Sex is still a major stumbling block for parents who are embarrassed to talk about it to their children. These books will be an outstanding asset to every parent in explaining the facts of life to an inquisitive youngster. The first three books listed are geared to ages 4 through 9, and the second set for ages 8 through 12.

Weather and Health, Helmut E. Landsberg. Doubleday. (\$4.95). Another in Doubleday's Anchor Science Study series, this one is an introduction to biometeorology. While most of us are familiar with the science of meteorology, we're not sure what the prefix "bio" does to it. This relatively new phase of that science deals with the relations between atmospheric and life processes: how crops depend on the weather, how animals mate, migrate and hibernate in annual cycles and in relation to the weather and how the environment affects our well-being. It's a subject of newsworthy interest and it comes in paperback too.

Invention, Discovery and Creativity. A.D. Moore. Doubleday. (\$4.95). Here is an encouraging and incentive-building book that says if you have the desire to do something you can. It's part of Doubleday's Anchor Science Study series, and is mainly aimed at the young student who's thinking about where he wants to go. Also available in paperback.

Understanding Maps. Beulah Tannenbaum and Myra Stillman. Mc-Graw-Hill. (\$5.95). A map is one of those taken-for-granted items of everyday life. We seldom think about the work that went into producing it

and the frequency with which it has to be revised. It's an involved process, and maps are interesting pieces of "art." While this book is quite elementary, nevertheless it acquaints us with a subject in which few are well-versed.

Snakes: the Keeper and the Kept. Carl Kauffeld. Doubleday. (\$5.95). If your biggest ambition is to have a pet snake, here's the book for you. It is quite a complete guide to selecting, feeding, caging and just generally caring for snakes as pets. The author, director and curator of reptiles at New York's Staten Island Zoo, also throws in a few exciting adventures he has experienced in over 40 years of dealing with snakes. Actually, it's quite interesting even if it isn't your biggest ambition to have a pet snake.

Brain Puzzler's Delight. E. R. Emmet. Emerson Books. (\$4.95). Reasoning is the key to this collection of mind teasers, with no specialized mathematical knowledge required. It's fun, but some of them get bit tough. Explanatory solutions are included too, though.

Another Look at Atlantis and 15 Other Essays. Willy Ley. Doubleday. (\$5.95). Although the title emphasis here is on Atlantis, the essay itself is neither longer nor more outstanding than the other essays. Several others actually are much more interesting, such as "Let's Build an Extraterrestrial," which discusses how science fiction writers have depicted creatures from other planets—and how many of those writers have quietly avoided the task. There's also a look at the "Death of the

Sun" and "Hunting the Dodo." It's good book with a comprehensive look at many intriguing subjects.

The Archaeology of New York State. William A. Ritchie. The Natural History Press. (\$15.00). A most thorough study of ancient man in New York, this book is a revised edition of the 1965 volume with the numerous excavations and discoveries that have taken place in the past four years. All major archaeological sites are described in detail.

The Intimate Enemy. George R. Bach and Peter Wyden. William Morrow and Co. (\$7.50). A practical guide on "How to Fight Fair in Love and Marriage," based on clinical testing of couples in the Institute of Group Psychotherapy, Beverly Hills, Calif., of which Dr. Bach is director. The psychologist advocates fighting for married couples instead of "game-playing," which is much more detrimental to the marriage, but the fighting has to be fair to be healthful. In the clinic, couples are instructed as to proper techniques, which are also offered to the reader in a self-training program. It's an intriguing book, whether or not you think your marriage needs any outside help.

Science and the Human Condition in India and Pakistan. Edited by Ward Morehouse. The Rockefeller University Press. (\$7.50). The economic, cultural, educational and practical problems involved in introducing science into the everyday existence in these countries is the purpose of this book, which is composed of essays that are based on a conference on international programs and services.

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Letters to the Editor

Marriage game not for toys

Your article, "The marriage game," in the April 1969 issue, was ridiculous. Psychiatrists who think that playing with toy trains reveals information about a person's marital life are in worse shape than their patients. Contrary to popular opinion, psychiatrists do not know everything.

> DAVID KINSELL Remington, Ind.

A misinterpretation

I have been employed by the World Health Organization-Pan American Sanitary Bureau for over 20 years, and know very well the position of

The following are answers to the quiz, "How well do you know your ologies?," which appears on page 39.

1. anthropology 2. archaeology 3. carpology

4. cenezoology 5. chromatology 6. clinology

7. comitology 8. cosmetology

9. cosmology 10. craniology

11. cryobiology 12. dendrology 13. diabolology

14. enology 15. esthematology 16. ethnology 17. exobiology

18. graphology 19. ichnology

20. ichthyology 21. koniology

22. kymatology 23. limnology 24. museology

25. myology 26. myrmecology 27. nidology

28. oneirology 29. oryctology

30. osphresiology

my office concerning the use and effects of marijuana. I was therefore shocked and surprised to read in your March 1969 issue (page 6, "Bulletins at Press Time") that "The chronic effects of marijuana were scorned recently by . . . Committee organized by the World Health Organization."

The WHO has never "rejected or refused with contempt" the fact that marijuana does produce chronic effects on the users.

> SERGIO R. DOCAL Washington, D.C.

Science Digest did not intend to imply that WHO rejects the possibility that marijuana produces chronic effects. The sentence with which you find fault can be read two ways. It was intended to mean that WHO scorns the use of marijuana by scorning its chronic effects.—Ed.

Could the monkeys copy man?

I found the article, "The Creative Monkeys of Koshima," (page 80, April 1969), very interesting. Where do you think the monkeys learned how to wash their potatoes and separate sand from wheat? Could it be that they learned how to do this by seeing humans do it? Why can't the old ones learn to do the same thing?

> PAT HART Canton, N.C.

The scientists who have studied the monkeys on Koshima Island, Japan, think the monkeys learned to wash potatoes and separate sand from wheat from other monkeys because there are no people on Koshima. Monkeys and other animals have

been shown to have a "critical period" for learning complex behavior when they are young; if they do not learn the behavior at this time, they will not learn it at all, or they will have trouble learning it. This is true of people, too, but to a lesser extent than in animals.—Ed.

A 'maybe' vote for the UFOs?

In regard to your article, "A 'no' vote for the UFOs," (page 89, April 1969), in the last paragraph you state, "for the scientific fraternity, the subject is a closed book." You may be interested in the report of the Symposium on Unidentified Flying Objects, held July 29, 1968, by the House Committee on Science and Astronautics. Presenting papers were six university and corporation Ph.D.s specializing in some scientific area. Their consensus of opinion was that the subject of UFOs should be taken seriously and that world-

wide scientific study be undertaken to determine all possible facts about this phenomenon.

The verbatim report of this symposium is available through the Clearing House for Federal Scientific and Technological Information, 5285 Port Royal Road, Springfield, Va. 22151. The title to request is "Symposium on Unidentified Flying Objects—PB179541." The fee for this extensive report is \$3.00 per copy.

I hold the opinion of many that this report should be studied by all citizens regardless of which side of the UFO controversy they may take. After reading the report, I doubt if anyone could consider that the scientific fraternity considers this subject a closed book. It would be well for all scientific publications to encourage the public to be informed on all sides of this subject.

MARIANNA WIMBERLEY Kearney, Neb.

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Index to Volume 65

SCIENCE DIGEST

January through June, 1969

Titles listed in italics are less than a full page long. IBC indicates Inside Back Cover; IFC, Inside Front Cover.

Antenna Test Model of LES-6 Feb. 60 Apollo 10 Set to 60 May 4 Cooling Undergament tor Space Suits Mar. 30 Electron Gun for Industrial Welding Apr. 61 Fire Extinguisher for Outer Space Apr. 61 Heat Pipe for Spacecraft Jan. 59 Home Run for the Orbiting Astronomical Observatory Feb. 61 It Takes 350,000 People to Put 3 on the Moon Mar. 22 Lunar Medicine Feb. 19 More Startling Pictures of Space Feats June 4 Once We ve Reached the Moon Apr. 54 Remaking the World Apr. 54 Remaking the World Apr. 54 Remaking the World Apr. 54 Research to Lunar Yo-Yo, Apr. 54 Sate Return of Lunar Yo-Yo, Apr. 54 Six Cave Explorers Who Feb. 21 Six Cave Explorers Who Feb. 22 Six Cave Explorers Who Feb. 25 Six Cave Explorers Who Apr. 54 Shape of the Earth Feb. 25 Six Cave Explorers Who Apr. 55 Space Age Honeycomb Mar. 18C Space Window for Infilatable Structures Apr. 56 Life on Venus Mar. 80 AGRICULTURE, BOTANY AND GARDENING Easy Way to Explore the Apr. 36 Computing a Temple Jan. 21 Dusty Secrets of Hogup Cave Apr. 36 Computing a Temple Jan. 21 Dusty Secrets of Hogup Cave Apr. 36 Computing a Temple Jan. 21 Dusty Secrets of Hogup Cave Apr. 36 Computing a Temple Jan. 21 Dusty Secrets of Hogup Cave Apr. 36 Computing a Temple Jan. 21 Dusty Secrets of Hogup Cave Apr. 36 Computing a Temple Jan. 21 Dusty Secrets of Hogup Cave Apr. 36 Computing a Temple Jan. 21 Dusty Secrets of Hogup Cave Apr. 36 Computing a Temple Jan. 21 Dusty Secrets of Hogup Cave Apr. 36 Computing a Temple Jan. 21 Dusty Secrets of Hogup Cave Apr. 36 Computing a Temple Jan. 21 Dusty Secrets of Hogup Cave Apr. 36 Computing a Temple Jan. 21 Dusty Secrets of Hogup Cave Apr. 36 Computing a Temple Jan. 21 Dusty Secrets of Hogup Cave Apr. 36 Computing a Temple Jan. 21 Dusty Secrets of Hogup Cave Apr. 36 Computing a Temple Jan. 23 Annet Prompetity Apr. 36 Computing a Temple Jan. 21 D	AEROSPACE	Rich Groesus SecretsJan. 75
Sate Return of Lunar Yo-Yo, Apollo 8	Antenna Test Model of LES-6	Riddle of the Viking Cryptograms Jan. 7 Roman Palace Jan. 3 St. Peter's Throne Isn't May 4 Sybaris Revisited Mar. 75 12 Things Nobody Ever Knew About Stone Age and Iron Age Men May 26 The Walls Remember June 3 Who Put the Handprints on Prayer Rock? June 54 ART AND CRAFTS It Moves! It Glows! It's Art! Jan. 76 Jokes the Old Masters Used to Play May 12 Masterpieces Record Disease Mar. 75 Sculpting a Gorilla Apr. 35
Apollo 8 Satellite Weather Forecasting May 43 Shape of the Earth Feb. 22 Six Cave Explorers Who Lived Outside of Time Apr. 8 Space Window for Inflatable Structures Apr. 61 Star-shaped Rocket Fuel for Apollo May 62 Two for the Moon Apr. 32 Will Men Ever Explore the Planet Pluto? May 87 Eden Under a Geodesic Dome Apr. 68 Lite on Venus May 80 Nature's Law of Succession June 86 Portable Greenhouse Jan. 30 ANTHROPOLOGY AND ARCHAEOLOGY Another Pompeil? Apr. 36 Computing a Temple Jan. 21 Dusty Secrets of Hogup Cave Mar. 34 Living Stone Age Americans Apr. 34 May 18 e Wrong Jan. 42 May 8 e Wrong Jan. 40 Mar. 80 Glant Fused Silica Mirror Jan. 21 Feb. 61 Glant Fused Silica Mirror Jan. 22 Life on Venus Mar. 80 Astronomical Observatory Feb. 62 Itie on Venus May 87 A New Planet May Have Been Born May 6 A New Planet May Have Been Born May 6 Where Are Those Pulsars? Jan. 23 Will Men Ever Explore the Planet Pluto? May 87 ATOMIC SCIENCE AND TECHNOLOGY High Voltage Generator Feb. 61 Nuclear Explosions: Useful Tools? June 7 ANTHROPOLOGY AND ARCHAEOLOGY Ancient Necklets Found Feb. 22 Another Pompeil? Apr. 36 Computing a Temple Jan. 21 Dusty Secrets of Hogup Cave Mar. 34 Living Stone Age Americans Apr. 34 Mar Is No Swinger May 74 The Medieval Riddle of Bodies in the Bog Feb. 9 Paint-on Preservation for Ancient Stone May 77 Persistent Pueblo Culture Apr. 59 Tire Testing on Glass Mar. 55 Apr. 36 Computing a Temple Short May 77 Persistent Pueblo Culture Apr. 59 ATOMIC SCIENCE AND TECHNOLOGY AUTOMOTIVE ENGINEERING AUTOMOTIVE ENGINEERING AUTOMOTIVE ENGINEERING Sattery Produces More Energy Jan. 59 Car Crash Victims On Natural Gas Jan. 60 Car That Runs on Natural Gas Jan. 62 Car That Runs on Natural Gas Jan. 62 Shattered Glass That Can't Cut Mar. 19 Shattered Glass That Can't Cut Mar. 19 Shattered Glass That Can't Cut Mar. 19 Shattered Glass That Can't Cut Mar. 55 Tire Testing on Glass	Pace	ASTRONOMY
Ancient Necklets Found Feb. 22 Another Pompeii? Apr. 36 Computing a Temple Jan. 21 Dusty Secrets of Hogup Cave Mar. 34 Living Stone Age Americans Apr. 34 Man Is No Swinger May 74 The Medieval Riddle of Bodies in the Bog Feb. 9 Paint-on Preservation for Ancient Stone Age May 74 Ancient Stone May 77 Ancient Stone May 77 Ancient Stone May 77 Ancient Stone May 77 Spersistent Pueblo Culture Apr. 59 Battery Produces More Energy Jan. 59 Car That Runs on Natural Gas Jan. 6 Car That Runs on Inviters Jan. 6 New Skid Control Device May 19 Rear-end Collision Inviters Jan. 22 Shattered Glass That Can't Cut Mar. 19 Sho-Cat for Springtime Mud May 25 Tire Testing on Glass Mar. 55	Sate Return of Lunar Yo-Yo, Apollo 8 Feb. Satellite Weather Forecasting May 43 Shape of the Earth Feb. 22 Six Cave Explorers Who Lived Outside of Time Apr. 8 SNAP-8 for Power in Space Jan. 59 Space Age Honeycomb Mar. IBC Space Window for Inflatable Structures Apr. 61 Star-shaped Rocket Fuel for Apollo May 62 Two for the Moon Apr. 32 Will Men Ever Explore the Planet Pluto? May 87 AGRICULTURE, BOTANY AND GARDENING Easy Way to Explore the Everglades Feb. 37 Eden Under a Geodesic Dome Apr. 68 Life on Venus Mar. 80 Nature's Law of Succession June 86	"Big Bang" Theory of Universe May Be Wrong The Core of Mars Tast-flashing Star May Be a Pulsar Mar. 3f Fast-flashing Star May Be a Pulsar Mar. 6G Glant Fused Silica Mirror Jan. 22 Home Run for the Orbiting Astronomical Observatory Itsy Bitsy Icarus? Apr. 58 Life on Venus Mar. 80 Look Out for Meteors A New Planet May Have Been Born A New Planet May Have Been Discovered The Sky Is Falling—But Don't Duck Where Are Those Pulsars? Jan. 23 Will Men Ever Explore the Planet Pluto? ATOMIC SCIENCE AND TECHNOLOGY High Voltage Generator Feb. 61
Ancient Necklets Found Feb. 22 Another Pompeii? Apr. 36 Computing a Temple Jan. 21 Dusty Secrets of Hogup Cave Mar. 34 Living Stone Age Americans Apr. 34 Man Is No Swinger May 74 The Medieval Riddle of Bodies in the Bog Feb. 9 Paint-on Preservation for Ancient Stone Age May 74 Ancient Stone May 77 Ancient Stone May 77 Ancient Stone May 77 Ancient Stone May 77 Spersistent Pueblo Culture Apr. 59 Battery Produces More Energy Jan. 59 Car That Runs on Natural Gas Jan. 6 Car That Runs on Inviters Jan. 6 New Skid Control Device May 19 Rear-end Collision Inviters Jan. 22 Shattered Glass That Can't Cut Mar. 19 Sho-Cat for Springtime Mud May 25 Tire Testing on Glass Mar. 55	ANTHROPOLOGY AND APCHAEOLOGY	AUTOMOTIVE ENGINEERING
Another Pompeii? Apr. 36 "Can Opener" Rescues Computing a Temple Jan. 21 Car Crash Victims Mar. 20 Dusty Secrets of Hogup Cave Mar. 34 Living Stone Age Americans Apr. 34 Car That Runs on Natural Gas Jan. 6 Car That Runs on Natural Gas Jan. 6 Car That Runs on Natural Gas Jan. 6 Cruising at 100 Mar. 29 Grooving Underwater June IFC New Skid Control Device May 19 Bodies in the Bog Feb. 9 Paint-on Preservation for Ancient Stone May 77 Ancient Stone May 77 Persistent Pueblo Culture Apr. 59 **Tire Testing on Glass Mar. 55 **Tire Testing on Glass Mar. 50 **Tire Testing on Glass Mar. 20 **Tore Testing on Gl		
	Another Pompeii? Apr. 36 Computing a Temple Jan. 21 Dusty Secrets of Hogup Cave Mar. 34 Living Stone Age Americans Apr. 34 Man Is No Swinger May 74 The Medieval Riddle of Bodies in the Bog Feb. 9 Paint-on Preservation for Ancient Stone May 77 Persistent Pueblo Culture Apr. 59	"Can Opener" Rescues Car Crash Victims

The Geology of New York City AVIATION and Environs, by Christopher J. SchuberthFeb. 93 Bridges, Canals and Tunnels, Can Passengers StandApr. 62 by David Jacobs and Anthony E. Neville Feb. 93 Island of Adventure. Decreasing Noise From Giant Aircraft May 63 Engineering Shambles: SST Jan. 34 France's SST Touches Down May 40 Jet-shaped Hangar June 58 Most Powerful Jet Engine Feb. 61 Soviet Union Tests Its by Ross E. Hutchins Feb. 93 The Circle of Fire, by Carl Heintze . Feb. 93 Pogonomyrmex Harvester Ants, by Arthur C. Cole Jr.Feb. 93 99 Ways to Use Your Soviet Union Tests Its Oscilloscope, by A.C.W. Saunders . Feb. 93 RCA Solid-State Hobby Circuits ManualFeb. 93 Diary of a Heart Patient, by Yehuda KestenFeb. 93 Engineers Unlimited: Your BIOLOGY Career in Engineering, Another Breakthrough in by Harry Edward NealFeb. 96 Synthesis of Vital Matter ... Apr. 4 Biological Clocks ... Jan. 78 Built-in Virus-lighter ... Mar. 78 Chemical Transfer of Fear ... Apr. 58 Disease Detectives: Your Career in Medical Research, by Harry Edward NealFeb. 96 Your Career in Oceanology, Daily Calorie Allowance for by Waldo T. BoydFeb. 96 Science Year, The World Book Science Annual: 1968Feb. 96 Adults Lowered ... Jan. 6 Lasers Chart Nerve Paths ... Apr. 34 Murder by Chromosomes? ... Jan. 24 Nature's Law of SuccessionJune 86 The Amateur Astronomer's Now We're Worth \$3.50 June 57 Obesity Starts in Childhood May 58 Secrets of Disease Immunity June 6 Secrets of the Brain Discovered June 57 Handbook, by James MuirdenFeb. 96 The Peter Principle, by Laurence J. Peter and We're More Like PigsApr. 59 Your Chemical ThermostatMay 81 Your Weight Problem May Not Be Your Fault May 6 Mind Drugs, edit. **BOOK REVIEWS** by Margaret O. HydeMar. 91 In the Wake of the Sea-Serpents, Cure for Cancer-A National Goal, by Bernard Heuvelmans Jan. 84 Toward the Year 2018, edit. by the Foreign Policy Association .Jan. 85 Panama, Part 2, Gene Control in the Living Cell, by J. A. V. Butler Jan. 85 Life, Death and the Doctor, by Louis Lasagna, M.D.Jan. 85 Telescopes: How to Choose and Use Them, by Terry Maloney .Jan. 85 Bankers, Bones and Beetles, by Geoffrey Hellman The Kensington Rune Stone, by Theodore C. BlegenApr. 91 Animal Societies, by Rémy Chauvin .Apr. 91 edit. by Paul Bohannan and John MiddletonJan. 86 Minged Rocketry, by Major James C. Sparks, USAF (Ret.) Jan. 86 The Tides: Pulse of the Earth, by Edward P. Clancy Jan. 87 edit. by Edgar M. CortrightMay 92 Around the World—a View from Space, pub. by Rand McNally The Big Machine, by Robert Jungk ..Jan. 87 Man and Heredity, His Ideas, by Richard I. Evans May 93 America's First Civilization: by G. W. Roderick Courtship: An Ethological Study, by Margaret Bastock Jan. 87 1969 Britannica Yearbook of Science and the Future Jan. 87 The World of the Grizzly Bear, G. & C. Merriam Webster's Seventh New Collegiate Dictionary by W. J. Schoonmaker Hummingbirds and Their Flowers, by Karen A. Grant and Jan. 87 Verne Grant When Nature Runs Wild, by Thomas P. JohnsonJan. 87 Earth, Moon and Planets, Technology, by Ronald Brown May 94

Your Future in Computer

Programming, by Sidney Davis May 94

by Fred L. WhippleFeb. 92

Medicine on Trial, by Dannie Abse .June 88 Project Icarus, edit. by Louis A. KleimanJune 89 Wild Reituge, by George LaycockJune 89 The Bronx Zoo Book of Wild Animals, by William Bridges .June 89 Homes Beneath the Sea, by Brois Arnov JrJune 89 Enzymes—the Agents of Life, by David N. LockeJune 90 Animal Expressions, Animal Weltere Institute	Nose Spray Stuffiness
Welfare Institute	Boys Read Fast Too May 7 Electrostatic Generator for Science Classrooms May 1 The Family in Crisis Mar. 5 Fascinating New Careers In Geography June 7 It Moves! It Glows! It's Art! Jan. 7 MDs Without Education Mar. 1
CHEMISTRY	Out With Books/In With Movies May 7
The Heaviest Element Yet MadeJune 6 Now We're Worth \$3.50June 57 Paint-on Preservation for Ancient	Out With Books/In With Movies May 7 Physics for Girls Only May 4 Roots of Scholarliness Feb. 7 Underprivileged Children's I.Q.'s Raised What Is Theoretical Physics? June 8
Stone	What is Theoretical Physics?June 8
New Element Jan. 6 Shattered Glass That Can't Cut Mar. 19 Tea Power June 72	ELECTRONICS AND ELECTRICITY
COMMUNICATIONS	Can Your Color TV Stand a Radiation Count?
Antenna Test Model of LES-6 Feb. 60 Better Telephone Service June 58 Can Your Color TV Stand a Radiation Count? Apr. 24 Chimp Human Chit-chat Feb. 73 Deat Make Long-Distance Telephone Calls Feb. 8 Formant Generator Synthesizes Speech Apr. 60 Laser TV Display System Mar. 54 LSI: Micro-mini Circuits Jan. 43 Microwave Reflectors Jan. 58 Miniaturized TV Camera Jan. 58 Mini-phone Weighs 75½ Ounces June 37 Movies From Way Back Apr. 36 Out With Books/In With Movies May 76 Picture Machines for Crime Fighting May 18 Portable Executive Phone Apr. 23 Teen Medical Advisors Mar. 78 The Underground Movie Thing June 43	Cells That Learn Electronically Mar. 52 An Electric Fog to Smother Ashma Apr. 74 Electrical Components Made Obsolete June 56 Electrostatic Generator for Science Classrooms May 19 How Good an Electrician Are You? May 86 Lighweight Electronic Calculator June 37 Live X rays on TV Tube Jan. 56 LSI: Micro-mini Circuits Jan. 45 Microminiature Circuits for IBM Computer May 66 Microwave Reflectors Jan. 58 Miniaturized TV Camera Jan. 58 Most Efficient Light Bulb Mar. 54 Push-button Pain Reliever June 62 Static Electricity Feb. 62 Story in a Needle's Eye Apr. IBC Tiny Crystal Stores 1,000 Holograms Mar. 54 EXPLORATION Easy Way to Explore the Everglades Feb. 37
Cavity-causing Toothpaste	Riddle of the Viking CryptogramsJan. 7
Dentist's ChairFeb. 8 Spot Check for Fluoride SafetyJune 71 Teeth Transplanted	EYES AND VISUAL AIDS
Tooth Decay Beaten for Good	Artificial Cornea Feb. 70 New Sight With Sound Apr. 53 Non-bibulous Baggy Eyes Apr. 53 Seeing Eye Dog for a Dog Mar. 39 Self-locusing Glasses Mar. 21 Your Vision Feb. 89
DRUGS AND ANTIBIOTICS	Your visionFeb. 89
An Additional 20 Years of Health Mar. 4 Antibiotics—What Are They? Jan. 79 Automated Injections Feb. 71 Built-in Virus-fighter Mar. 78 The Chronic Effects of Marijuana Mar. 6 Drug Addiction Is Not Physiologic May 20 Drugs Fight Anxlety Neurosis May 58 Hong Kong Flu Vaccine Feb. 71	FOOD AND DIET Chinese Food Mystery Solved
Lunar MedicineFeb. 19	A Fish StoryFeb. 21

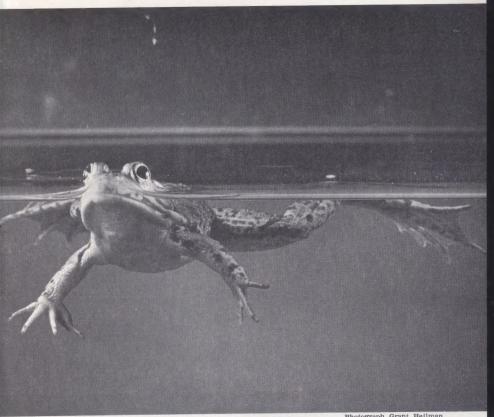
Football Exercise FolblesApr.	55 Housewite of 1975Feb. 24
Insects Are Good to EatApr Miasma of MainutritionMay	4 Mini Air Hammer
Nutrition by Vein	66 in the Sky
Nutrition by VeinJan. Obesity Starts in ChildhoodMay	58 New Sky-scraper in JonannesburgJune 50
Real Brain Food	
Rock-hard Rice to Save the	recinique
Starving WorldFeb	72 Suburban Isolation ControversyJune 28
lea Power	72 Copulpair lociation Contrologycane
That Barnyard Chicken FlavorMar. Tooth Decay Beaten for GoodMay	57
The Wacky World of Food FadsFeb.	80 INDUSTRY AND ENGINEERING
Your Weight Problem May Not Be	
Your FaultMa	Air Curtain Screens BacteriaMay 61
	"Airbrasive" Cuts and Cleans Apr. 61
	Aleutian Runaway
GEOGRAPHY	Battery Produces More EnergyJan. 59
Death and GeographyApr.	35 Better Telephone ServiceJune 58
Fascinating New Careers in	Breakthrough in Ice BreakingJan. 15
GeographyJune Our Working Satellites Are	Magnetism May 19
Remaking the WorldApi	Magnetism
Shape of the EarthFeb.	22 Cleaning Fine JewelryFeb. 25
	Computerizing Heart PatientsApr. 22
	Cambridge Page-turner .Apr. 22 22 Cleaning Fine Jewelry .Feb. 25 Computerizing Heart Patients .Apr. 22 Computing a Temple .Jan. 21
GEOLOGY	Concrete Preservative
Broken Crockery?Jan. I	Computing a Temple State Value of the Crazy Things They'll Use to Build Your New House Feb. 42 Cruising at 100 Mar. 29 Dead Oil Fields Revived
Dusty Secrets of Hogup Cave Mar.	34 Cruising at 100 Mar. 29
Fruntian Brigade	22 Dead Oil Fields Revived
The Great Dinosaur Disaster Mar. How Good a Geologist Are You? Mar.	by Computer
Last Continent - Maybe	Decreasing Noise From
Lost Continent—MaybeJune The New Time MachineApr.	37 Giant Aircraft
Secrets of Volcanoes June Spreading Primordial Ooze May Two New Volcanoes in AntarcticaJan	Diagnosing Disease by Computer May 38 ECG by Telephone
Spreading Primordial OozeMay	40 Eden Under a Geodesic DomeApr. 68
Two New Voicanoes in AntarcticaJar	1. 6 Electron Gun for Industrial Welding .Apr. 61
U.S. Had Over 250 Earthquakes in 1968Ma	Electron Scanning MicroscopeJan. 26
Voicanoes—From Dormant to Deadly Apr.	
Voicanoes Trom Bonnant to Board, The	ObsoleteJune 59
	Electronic Thermometer
HEART AND BLOOD	Film Keeps Heat OutApr. 60
Blood Diseases and PetsJan.	Fire Extinguisher for Outer Space Apr. 61
Blood Pressure Rypass	
Chalasteral and Health	/5
Cola and CholesterolMar. Computerizing Heart PatientsApr.	Fry an Egg on a Coffee Table May 18
ECG by Telephone	Germ-free Baby Chamber
Hinte for Heart Patients	68 Giant Fused Silica Militor
Hypertension SurgeryJan Hypoglycemia—the Disease That	65 Heat Pipe for Spacecraft
Hypoglycemia—the Disease That	High Voltage GeneratorFeb. 61
Makes Women lifed	Housewife of 1975Feb. 24
Lightning Victims—Back From the DeadJan	40 High Voltage Generator Feb. 61 Housewife of 1975 Feb. 25 64 Hoversprite Air-cushion Vehicle Feb. 25 21 Hydra—for Bottom Lowdown Feb. 76 11 Moves! It Glows! It's Art! Jan. 76
Man-made Blood Vessels Feb Microsurgery: Big New Hope Me Next: You May Control Your	21 Hydra—for Bottom LowdownFeb. 76
Microsurgery: Big New HopeMa	It Takes 350,000 People to
Next: You May Control Your	Put 3 on the Moon
Own Heartbeat	Put 3 on the Moon
Cmoking and Your Heart May	Jet-shaped HangarJune 58
Smoking and Your HeartMay Storing Varicose VeinsMar	at legar Heam Printing
Otomis variation value visit variation	Laser TV Display System
	Lead III IIIe Head
HOUSING AND HOME AIDS	Light-beam Control System for ParalyticsJune 37
Burglar-proof Lock Uses Coded	Light Tube for Remote Reading Feb. 60
MagnetismMa	19 Lightweight Electronic CalculatorJune 37
Magnetism Ma Cleaning Fine Jewelry Feb Concrete Preservative Ma The Crazy Things They'll Use to	y 19 Lightweight Electronic CalculatorJune 37 . 25 Live X rays on TV TubeJan. 58Jan. 43Live X rays on TV TubeJan. 43Live X rays on TV TubeJan. 58
Concrete PreservativeMa	Man-made Blood VesselsFeb. 21
"Destroyit" Westenesket	a 36 Microminiature Circuits for
Eden Under a Geodesic DomeApr	. 68 IBM Computer
Eden Under a Geodesic DomeApr Film Keeps Heat OutApr Fry an Egg on a Coffee TableMa	. 60 Microwave Reflectors
Fry an Egg on a Cottee TableMa	y 10 milli All Hallings

Miniaturized TV CameraJan. 58	MEDICINE
Mini-phone Weighs 15½ OuncesJune 37 Most Efficient Light BulbMar. 54	
Most Powerful Jet Engine Feb 61	An Additional 20 Years of Health Mar. 4 Aging—the Disease With a Cure Feb. 32
A Needle-shaped City High in the Sky Feb.	Air Curtain Screens Bacteria May 61
A Needle-shaped City High in the Sky Feb. New Sky-scraper in Johannesburg . June 58 Nuclear Explosions: Useful Tools? . June 7 Palantype Shorthand Machine Jan. 58	Air-driven Stretcher Relieves
Palantype Shorthand Machinelan 58	Stiff Neck
Picture Machines for Crime Fighting May 18	Synthesis of Vital Matter
Portable Executive Phone Apr 23	Antiblotics—What Are They?Jan. 79
Propeller for Submersibles Jan. 59 Seeing Through Fog Mar. 54	Anxiety: Cheap Neurosis for EveryoneJune 65
700-pound Glass Hemisphere	Artificial Cornea Feb 70
for Underwater Research Vessel May 63 Shattered Glass That Can't Cut Mar. 19	Automated InjectionsFeb. 71
Shock Protection ChairsMar. 21	
Skyscraper Uses Ancient	Blood Diseases and PetsJan. 68
Building Technique Mar. 55 SNAP-8 for Power in Space Jan. 59	Big Smoke, Little Bables Apr. 52 Blood Diseases and Pets Jan. 68 Blood Pressure Bypass Feb. 69
Space Ade Hollevcollip	Boy or Spaceman? Feb. 25 Breathing Monitor for Bables Feb. 69
Space Window for Inflatable	Built-in Virus-fighter Mar 78
Structures	Cambridge Page-turner
	Cancer Cream Shows PromiseApr. 56
Submarine Crews Rescued by DSRV June 59 This Bomb May Go OffJune 27	Cancer Patients Will Ro Ablo
This Bomb May Go OffJune 27 Tiny Crystal Stores	to Cure Themselves
1.000 Holograms Mar 54	Cholesterol and HealthFeb. 75
Tire Testing on GlassMar. 55	Corree Break Smoke TrapFeb. 70
Tire Testing on Glass Mar. 55 Videofile System Feb. 61 X-raying the Ocean Floor Feb. 74	Cola and CholesterolMar. 74 Computerizing Heart PatientsApr. 22
7. 12 july 110 0 0 0 0 0 1 1 1 1 1 1 1 1 1 1 1 1	Death and GeographyApr. 22
11/244ma	Death and Geography
INSECTS	
Formosan Termite Mar. 30 Insects Are Good to Eat	Diagnosing Disease by Computer May 38 Disease, Vietnamese Style May 60 Drug Addiction Is Not Physiologic May 20
The Nosey Kind	Drug Addiction Is Not Physiologic . May 20
Poisonous ButterfliesFeb. 23	FCG by Telephone May 95
	Drugs Fight Anxiety Neurosis May 58 ECG by Telephone May 85 An Electric Fog to Smother Asthma Apr. 74
INVENTIONS, PATENTS AND PROCESSES	Electronic Thermometer Jan. 30 Flu May Hide in Animals June 62 Freston (mmontality)
CAT Means Bad Luck to PilotsJan. 69	Frozen Immortality?
Cells That Learn Electronically Mar. 53 ECG by Telephone	Frozen Immortality? June 33 Germ-free Baby Chamber May 61
ECG by Telephone	Hiccups—the Good-for Nothing
Laser Beam Printing Feb. 72 The Marriage Game Apr. 79	ReflexJan. 70 Hints for Heart PatientsFeb. 68
Spot Check for Fluoride SafetyJune 71	Hong Kong Flu Vaccine Feb 71
	The Hypnotic Type
MARINE BIOLOGY	Hypertension Surgery
Fossil Jollytish Fob 75	Makes Women Tired
Fossil Jellylish	Kidney Donors Decide FastMar. 76
New Whale for an Old Fish Hall Mar. 12	Reassuring?June 60
Sea Cow in Loch Ness?	Last Rites—Frightening or Reassuring? Lead in the Head Lead in the Head Light-beam Control System
Porpoise to the Rescue June 35 Sea Cow in Loch Ness? Apr. 33 Sea Monster of a Turtle Feb. 21	tor ParalyticsJune 37
Tattooed Lobsters	Lightning Victims—Back
	From the Dead
MARRIAGE AND FAMILY	
Birth Control in SwedenMar. 4	Masternieros Record Diseason May 75
The Family in Crisis	MDs Without Education Mar. 14 Medical Magnet Jan. 30 Miasma of Mainutrition May 75 Microsurgery: Big New Hope May 7 New Sight With Sound
The Fertile Folk	Miasma of Mainutrition May 75
The Marriage GameApr. 79 "Prequest" Pregnancy TestFeb. 25	Microsurgery: Big New Hope May 7
, , , , , , , , , , , , , , , , , , , ,	New Sight With Sound Apr. 53 Next: Voice Transplants Feb. 69
MATHEMATICS	Next: You May Control Your
	Own Heartbeat May 57 Nighttime Allergies Jan. 68
Imaginary Numbers	Nose Spray Stuffiness Fab. 70
Ordinary Vs. Binary Numbers Apr. 83	Nutrition by VeinJan. 66
The Truth in Gödel's ProofFeb. 86	Nose Spray Stuffiness Feb. 70 Nutrition by Vein Jan. 66 Obesity Starts in Childhood May 58 Poor Feel Poorly Feb. 22
Ordinary Vs. Binary Numbers Apr. 83 The Truth in Gödel's Proof Feb. 86 U.S. Leader in Math Mar. 30 What Is Theoretical Physics? June 85	Pregnancy Weight-gainJune 63
That to theoretical rilyalearulle 65	riognamo, riolgini gain

94

"Prequest" Pregnancy Test Feb. 25 Pressure Chamber X ray Feb. 24 Price-tagging Our Bodies June 62 Quacks—the Would-be MDs Who Can Harm You June 63 Relief From Gout June 63 Relief From Gout June 61 Resodding the Scalp Apr. 54 Secrets of Disease Immunity June 65 Should Doomed Be Told? Mar. 75 Sickening Noise Jan. 66 Six Cave Explorers Who Lived Outside of Time Apr. 8 Smoking and Your Heart May 58 Sneeze in the Sun Apr. 58 Spine Deformity No Handicap June 61 Spot Check for Fluoride Safety June 71 Storing Varicose Veins Mar. 74 Suicide Rate 1,000 a Day Jan. 4 Tea Power June 72 Teen Medical Advisors Mar. 78 Teeth Transplanted Jan. 67 Tooth Decay Beaten for Good May 57 We're All Dirty Birds Mar. 81 Why Some Pregnant Women Feel Faint May 81 Your Teeth Are Here to Stay June 22 Your Weight Problem May 6 AETEOROLOGY Another Ice Age? May 39 Antarctica's Ice Cap Is Growing June 62 Doughnut-shaped Raindrops Jan. 25 How Good Are You As a May 3 Storms That Rage Beneath the Sea Mar. 7	Another Embarrassing Egg Mar. IFC Australia's Embarrassing Egg Mar. 70 Beak-to-beak Tête-â-tête Apr. IFC Birds That Fly Nowhere Apr. 19 How Goes the Battle of the Whooping Crane? Feb. 15 Keas: Those Fine Feathered Villains of New Zealand May 69 Parrot Problems Apr. 36 Three "Extinct" Birds Rediscovered May 6 Trumpeter Is Back Mar. 28 PALEONTOLOGY Australia's Embarrassing Egg Mar. 70 Fossil Jellyfish Feb. 75 The Great Dinosaur Disaster Mar. 45 New Home for Old Bones Jan. 41 2,000-Year-Old Seal Apr. 57 PHOTOGRAPHY The Underground Movie Thing June 43 PHYSICS "Big Bang" Theory of Universe May Be Wrong Jan. 45 Can Anti-gravity Really Exist? May 86 Doughnut-shaped Raindrops Jan. 25 Earth Is Slowing Down Apr. 57 Next—A "Smell" Wheel Jan. 25 Physics for Girls Only May 40 Scientists on the Trail of Another New Element Jan. 6 Shape of the Earth Feb. 22 Static Electricity Feb. 62
Storms That Rage Beneath the Sea Mar. /	What Is Theoretical Physics?June 85
MINERALOGY AND METALLURGY	PHYSIOLOGY Aging—the Disease With a CureFeb. 32
Dead Oil Fields Revived by Computer Apr. 61 Rich Croesus' Secrets Jan. 75 Tanzanite May 70	Aging—the Disease with a Cure Feb. 52 Biological Clocks Jan. 78 Can Passengers Stand Supersonic Flight? Apr. 62 Do Sheep Count People When They Can't Sleep? Feb. 56 Football Exercise Foibles Apr. 55
MISCELLANEOUS See Cow in Loch Ness? Apr. 33	Historian the Cond for Nothing
Sea Cow in Loch Ness?	Reflex Jan. 70 Lasers Chart Nerve Paths Apr. 34 Next—A "Smell" Wheel Jan. 25 Real Brain Food Feb. 21 Rear-end Collision Inviters Jan. 22 Sex and the Senior Citizen Feb. 8
OCEANOGRAPHY AND NAUTICAL SCIENCE	Six Cave Explorers Who Lived
Aleutian Runaway May 64 Breakthrough in Ice Breaking Jan. 15 Deep-diving Frenchmen Mar. 32 Hoversprite Air Cushion Vehicle Feb. 25 Hydra—for Bottom Lowdown Feb. 76	Outside of Time
The New Time MachineApr. 37	PLASTIC SURGERY
The New Time Machine Apr. 37 Ocean System of the Future May 75 Photos of Nuclear Sub, "Scorpion" Apr. 4 Propeller for Submersibles Jan. 59 The Racing Tides Jan. 60 Saucer Hydroplane Apr. 22	Non-bibulous Baggy Eyes
700-pound Glass Hemisphere	PLASTICS
for Underwater Research Vessel May 63 Storms That Rage Beneath the Sea Mar. 7	The Crazy Things They'll Use to Build Your New HouseFeb. 42
for Underwater Research Vessel May 63 Storms That Rage Beneath the Sea Mar. 7 Submarine Crews Rescued by DSRV June 59 Yeaving the Ocean Floor Feb. 74	to Build Your New HouseFeb. 42 New Whale for an Old Fish HallMar. 12 Spray-foamed Plastic ChairApr. 23

POLLUTION OF ENVIRONMENT	SOCIOLOGY
Car That Runs on Natural GasJan. 6	Birth Control in Sweden
Worldwide Damage From DDT Pollution	The Family in Crisis
топаноп	Persistent Pueblo Culture
PSYCHIATRY AND PSYCHOLOGY	Poor Feel PoorlyFeb. 22
	The Family in Crisis Mar. 56 The Fertile Folk Mar. 27 Persistent Pueblo Culture Apr. 59 Poor Feel Poorly Feb. 22 The Underground Movie Thing June 43 Underprivileged Children's I.Q.'s Raised Mar. 58
Anxiety: Cheap Neurosis for EveryoneJune 65	ridibod
for EveryoneJune 65 The Chronic Effects of MarijuanaMar. 6 The Creative Monkeys of KoshimaApr. 80	The Walls RememberJune 31
The Creative Monkeys of KoshimaApr. 80 Drug Addiction Is Not PhysiologicMay 20	
Drugs Fight Anxiety Neurosis May 58	SPORTS AND RECREATION
The Family in Crisis	Football Exercise Foibles
Dentist's Chair Feb B	Loose Knees and FootballFeb. 67
The Hypnotic Type	Loose Knees and Football Feb. 67 "Lunar Trek" Toy Has Caterpillar Track June 36 Movies From Way Back Apr. 36 Skling Without Snow Jan. 31
King Henry "the Punchy"	Movies From Way Back
	Skiing Without SnowJan. 31
The Marriage Game Apr. 79 Murder by Chromosomes? Jan. 24 Sex and the Senior Citizen Feb. 8 Should Doomed Be Told? Mar. 75	
Sex and the Senior Citizen Feb 8	TRAVEL AND TRANSPORTATION
Should Doomed Be Told?Mar. 75	Cruises to Antarctica Mar 21
	Cruises to Antarctica
Tripping With Catnip	
Suicide Rate 1,000 a Day Jan. 4 Tripping With Catnip June 35 Underprivileged Children's I.Q.'s Raised	ZOOLOGY
Raised	
MarijuanaApr. 14	Another Embarrassing EggMar. IFC Beak-to-beak Tête-á-têteApr. IFC
Your Chemical Thermostat May 81	Birds That Fly NowhereApr. 19
	Birds That Fly Nowhere Apr. 19 Blood Diseases and Pets Jan. 68 Chimp Human Chit-chat Feb. 73
QUIZZES	The Creative Monkeys of Koshima Apr. 80
How Good a Geologist Are You?Mar. 86 How Good an Electrician Are You?May 89	The Disappearing ToadApr. 29 Do Sheep Count People When
How Good Are Vou As	Do Sheep Count People When
a Meteorologist?June 82	They Can't Sleep? Feb. 56 Electron Scanning Microscope Jan. 26 Formosan Termite Mar. 30 Freeze-dried Mouse Apr. 58
Signs of AgingJan. 81	Formosan Termite
a Meteorologist? June 82 Signs of Aging Jan. 81 Volcances—From Dormant to Deadly Apr. 86	Guppies—the Amazing
Your VisionFeb. 89	Guppies—the Amazing "Millions Fish" May 73 Hairless Mouse Bred Jan. 24
RADIATION AND LIGHT	Here Come Those Crazy GrunionJune 20 How Goes the Battle of the
Can Your Color TV Stand	Whooning Crane?
Experimental Optical Memory System Feb. 61	Whooping Crane? Feb. 15 Keas: Those Fine Feathered Villains of New Zealand
Laser Beam PrintingFeb. 72	Villains of New ZealandMay 69 Man Is No SwingerMay 74
Light Tube for Remote Reading Feb. 60	The Man Who Makes Pets
Live X rays on TV TubeJan 58	of Gorillas
Can Your Color TV Stand a Radiation Count? Experimental Optical Memory System Feb. 61 Laser Beam Printing Feb. 72 Laser TV Display System Mar. 54 Light Tube for Remote Reading Feb. 60 Live X rays on TV Tube Jan 58 Pressure Chamber X ray Feb. 24 Seeing Through Fog Mar. 54 X-raying the Ocean Floor Feb. 74	Nose-printing Cows Flops June 5/
Tiny Crystal Stores 1,000 Holograms Mar. 54	The Nosey KindMay IBC
A-raying the Ocean FloorFeb. 74	Poisonous Butterflies Feb 23
	Polar Bears Almost HibernateJune 6
RELIGION	Porpoise to the Rescue
The Fertile Folk	MarijuanaMar. 6
Last Rites—Frightening or Reassuring? June 60 St. Peter's Throne Isn't	Sculpting a GorinaApr. 35
St. Peter's Throne Isn'tMay 42	Sea Monster of a TurtleFeb. 21 Secrets of the Brain DiscoveredJune 57
	Seeing Eve Dog for a Dog Mar 39
REPTILES	A Summer SnoozeJune IBC
The Ugly AlligatorJune 34 A Venomous LookMay IFC	Three "Extinct" Birds Rediscovered May 6
A vendinous Look	Training Dogs for City TrafficJan. 23
SMOKING	The Ugly AlligatorJune 34
	Up-tight DogsMay 42
Big Smoke, Little Babies	Tattooed Lobsters Three "Extinct" Birds Rediscovered May 6 Training Dogs for City Traffic Jan. 23 Trumpeter Is Back Mar. 28 The Ugly Alligator June 34 Up-tight Dogs May 42 A Venomous Look May IFC We're More Like Pigs Apr. 59 Vinneed
Smoking and Your HeartMay 58	Yippeee!Jan. IFC



Photograph Grant Heilman

Up periscope

OOLOGISTS call this amphibian Rana catisbeiana — froglegslovers call it "delicious." Both groups of people require thousands of bullfrogs every year, but lately there haven't been enough of the jumpers to go around.

Sights like this periscope-eyed bullfrog are becoming few and far between mainly because of technical progress that demands that swamps be made more accessible to man.

The amphibians are in no immediate danger of extinction, but their numbers have dwindled to the point that they now have to be imported from Japan where frogs are plentiful but small.

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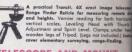
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